Allen-Bradley

LPM15 Liquid-Cooled Adjustable Frequency AC Drive

FRN 2.xxx

User Manual

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at **http://www.rockwellautomation.com/literature**) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary we use notes to make you aware of safety considerations.

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

Important: Identifies information that is critical for successful application and understanding of the product.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid the hazard, and recognize the consequences.

Shock Hazard labels may be located on or inside the equipment (e.g., drive or motor) to alert people that dangerous voltage may be present.

Burn Hazard labels may be located on or inside the equipment (e.g., drive or motor) to alert people that surfaces may be at dangerous temperatures.

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The information below summarizes the changes made to this manual since its last release (September 2005):

Description of Changes	Page
Since the LPM15 drive has no encoder feedback option, removed all encoder information and references.	Throughout Manual
Changed Table 4.F columns and information, and deleted Table 4.G and Table 4.H.	4-16

The information below summarizes the changes made to this manual since its last release (January 2005):

Description of Changes	Page
Added CE Low Voltage Directive instructions in the new “CE Conformity” section.	1-30

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Overview

The purpose of this manual is to provide you with the basic information needed to install, start-up, and troubleshoot the LPM15 Liquid-Cooled Adjustable Frequency AC Drive.

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Who Should Use this Manual?

This manual is intended for qualified personnel. You must be able to program and operate Adjustable Frequency AC Drive devices. In addition, you must have an understanding of the parameter settings and functions. The User Manual is designed to provide only basic start-up information.

Reference Materials

The following manuals are recommended for general drive information:

Title	Publication
Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives	DRIVES-IN001...
Preventive Maintenance of Industrial Control and Drive System Equipment	DRIVES-TD001…
Safety Guidelines for the Application, Installation and Maintenance of Solid State Control	SGI-1.1
A Global Reference Guide for Reading Schematic Diagrams	0100-2.10
Guarding Against Electrostatic Damage	8000-4.5.2

Publications can be obtained at http://www.rockwellautomation.com/literature.

Manual Conventions

- In this manual we refer to the LPM15 Adjustable Frequency AC Drive as; drive, LPM15 or LPM15 Drive.
- To help differentiate parameter names and LCD display text from other text, the following conventions will be used:
  - Parameter Names will appear in [brackets].
    For example: [DC Bus Voltage].
  - Display Text will appear in “quotes.” For example: “Enabled.”
- The following words are used throughout the manual to describe an action:

Word	Meaning
Can	Possible, able to do something
Cannot	Not possible, not able to do something
May	Permitted, allowed
Must	Unavoidable, you must do this
Shall	Required and necessary
Should	Recommended
Should Not	Not recommended

General Precautions

ATTENTION: This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, refer to Allen-Bradley publication 8000-4.5.2, “Guarding Against Electrostatic Damage” or any other applicable ESD protection handbook.

ATTENTION: An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures may result in malfunction of the system.

ATTENTION: Only qualified personnel familiar with adjustable frequency AC drives and associated machinery should plan or implement the installation, start-up, and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

ATTENTION: To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before performing any work on the drive. After removing power to the drive, wait 5 minutes for the bus capacitors to discharge. Measure the DC bus voltage at the locations shown in Figure 4.2, Figure 4.3 or Figure 4.4. The voltage must be zero.

ATTENTION: Risk of injury or equipment damage exists. DPI or SCANport host products must not be directly connected together via 1202 cables. Unpredictable behavior can result if two or more devices are connected in this manner.

ATTENTION: The "adjust freq" portion of the bus regulator function is extremely useful for preventing nuisance overvoltage faults resulting from aggressive decelerations, overhauling loads, and eccentric loads. It forces the output frequency to be greater than commanded frequency while the drive's bus voltage is increasing towards levels that would otherwise cause a fault. However, it can also cause either of the following two conditions to occur.

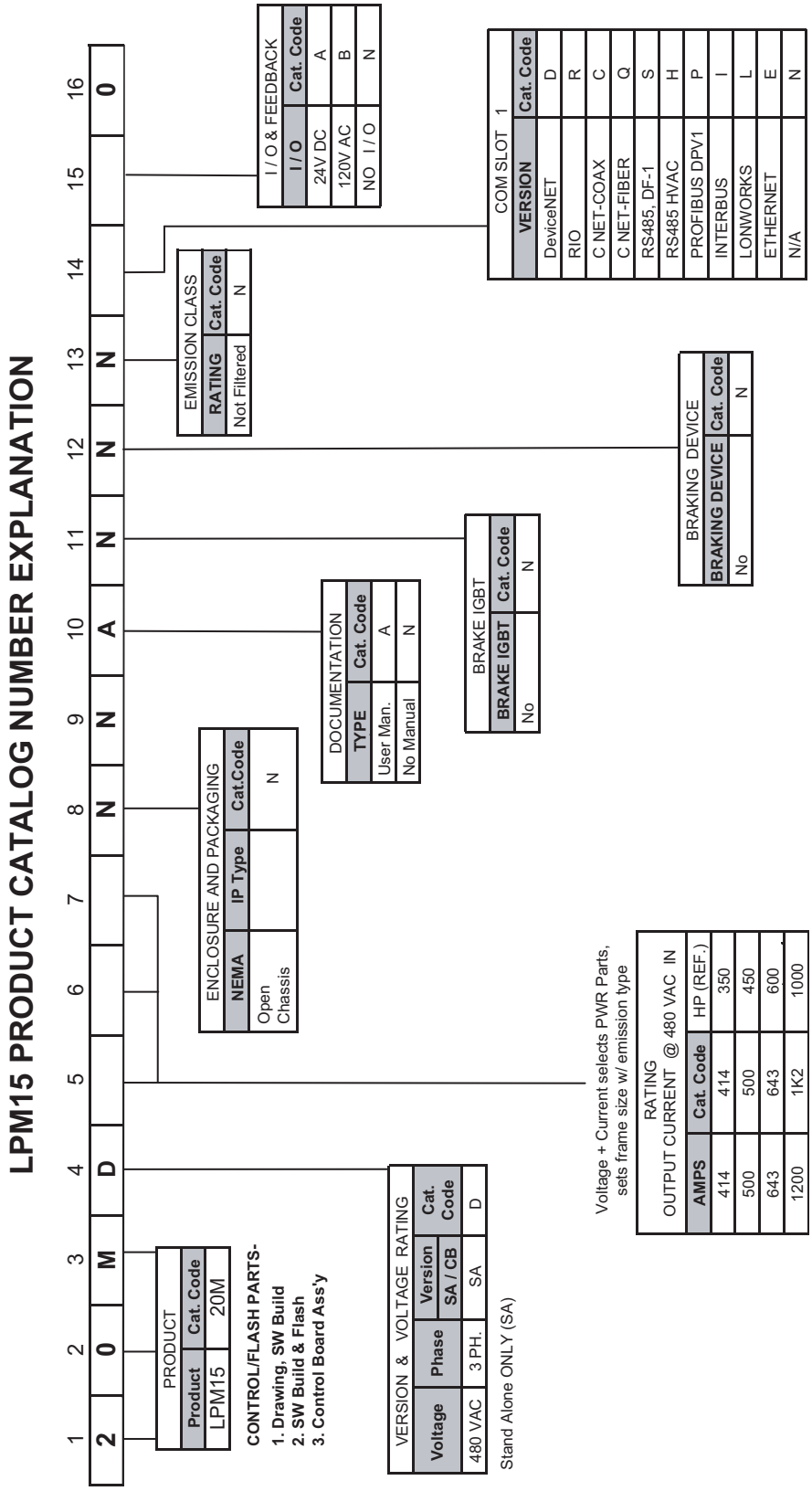
1. Fast positive changes in input voltage (more than a 10% increase within 6 minutes) can cause uncommanded positive speed changes. However an "OverSpeed Limit" fault will occur if the speed reaches [Max Speed] + [Overspeed Limit]. If this condition is unacceptable, action should be taken to 1) limit supply voltages within the specification of the drive and, 2) limit fast positive input voltage changes to less than 10%. Without taking such actions, if this operation is unacceptable, the "adjust freq" portion of the bus regulator function must be disabled (see parameters 161 and 162).

2. Actual deceleration times can be longer than commanded deceleration times. However, a "Decel Inhibit" fault is generated if the drive stops decelerating altogether. If this condition is unacceptable, the "adjust freq" portion of the bus regulator must be disabled (see parameters 161 and 162). In addition, installing a properly sized dynamic brake resistor will provide equal or better performance in most cases.

   Important: These faults are not instantaneous. Test results have shown that they can take between 2-12 seconds to occur.

Catalog Number Explanation

The LPM15 catalog numbering scheme is shown below.



Installation/Wiring

This chapter provides information on mounting and wiring the LPM15 Drive.

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Most start-up difficulties are the result of incorrect wiring. Every precaution must be taken to assure that the wiring is done as instructed. All items must be read and understood before the actual installation begins.

ATTENTION: The following information is merely a guide for proper installation. The Allen-Bradley Company cannot assume responsibility for the compliance or the noncompliance to any code, national, local or otherwise for the proper installation of this drive or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.

Power Ratings

LPM15 Drives have power ratings as described in Table 1.A below:

Table 1.A Power Ratings (1)

Catalog Number (positions 1-7 only)	Frame Size	Input Power (KVA)	Input Current (Amps)	Output Current at 2 kHz (2) (Amps)	HP Ratings	Full Load Power Loss Watts Fluid/Air
20MD414	B-Frame	344	414	414	350	4600/1100
20MD500	C-Frame	398	500	500	450	5500/1500
20MD643	C-Frame	512	643	643	600	7000/2000
20MD1K2	D-Frame	956	1200	1200	1000	11700/4000

(1) 110% output current capability for one minute, 150% output current capability for 5 seconds.

(2) Note that LPM15 drives are rated for use with water at specified temperatures and pressures as the coolant. Some coolant fluids may allow an increased output rating while others may require the output to be derated. LPM15 drives are also capable of running at 3 kHz or 4 kHz at reduced output.

Enclosure Ratings

LPM15 drives have the following enclosure rating:

- Open-Chassis Style: Intended to be installed in an enclosure.

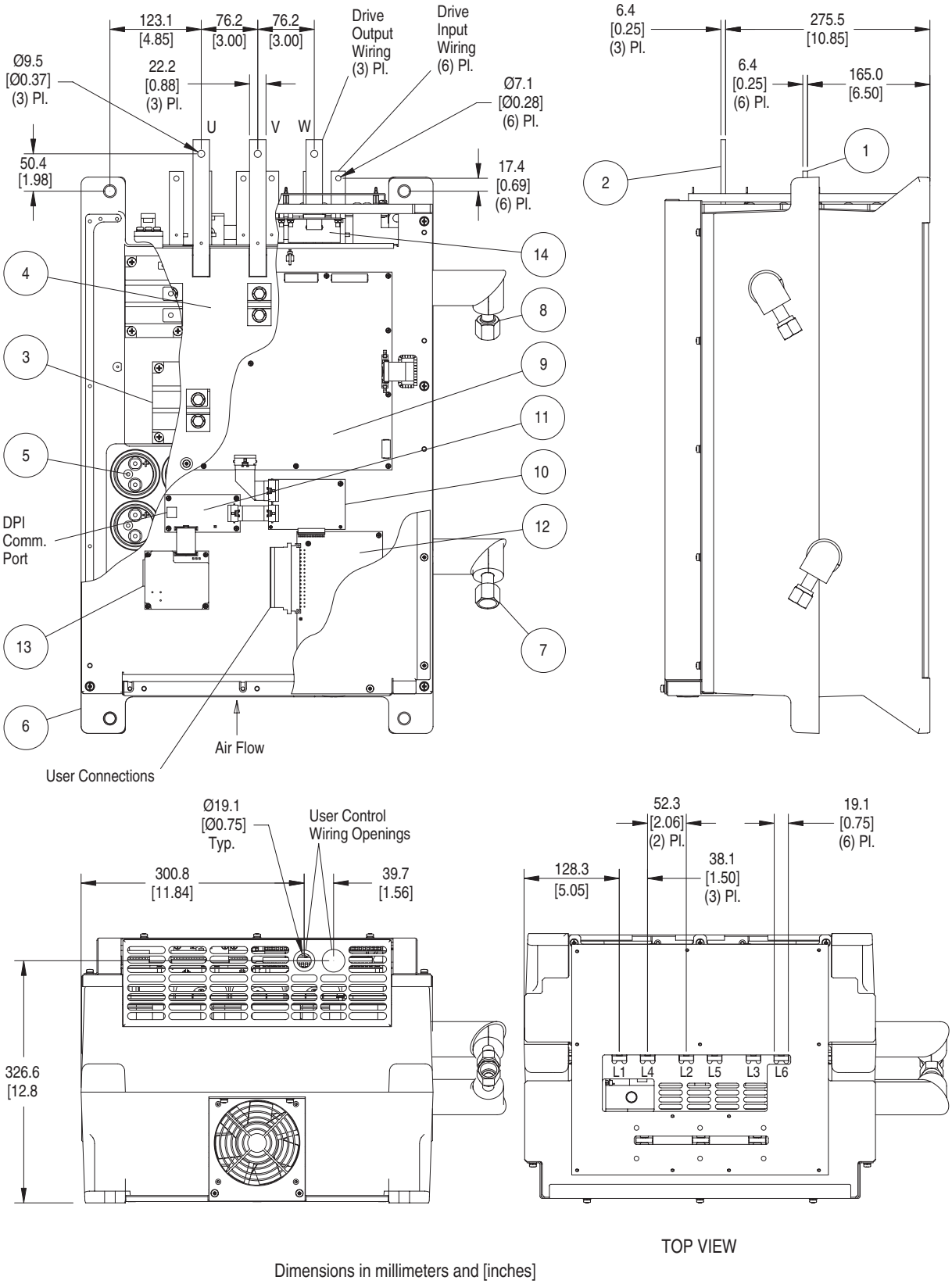
LPM15 drives must be placed in an enclosure.

B-Frame LPM15 Drive Component Locations

The B-Frame LPM15 drives have the following main components. The numbered items listed below correspond to the numbers used in Figure 1.1. Replacement parts are listed in Chapter 4.

1. AC Input Bus Bars (6)
2. AC Output Bus Bars (6)
3. IGBT Modules
4. Output Laminated Bus
5. Capacitors
6. Chassis (Heatsink)
7. Inlet Coolant Connection
8. Outlet Coolant Connection
9. Power Interface Control (PIC) PCB
10. Inverter Control PCB
11. Communication Interface PCB
12. Standard I/O PCB (Optional)
13. Communication Board (Optional)
14. Current Feedback Devices (3)

Figure 1.1 B-Frame LPM15 Drive Component, Wiring, Mounting and Coolant Locations



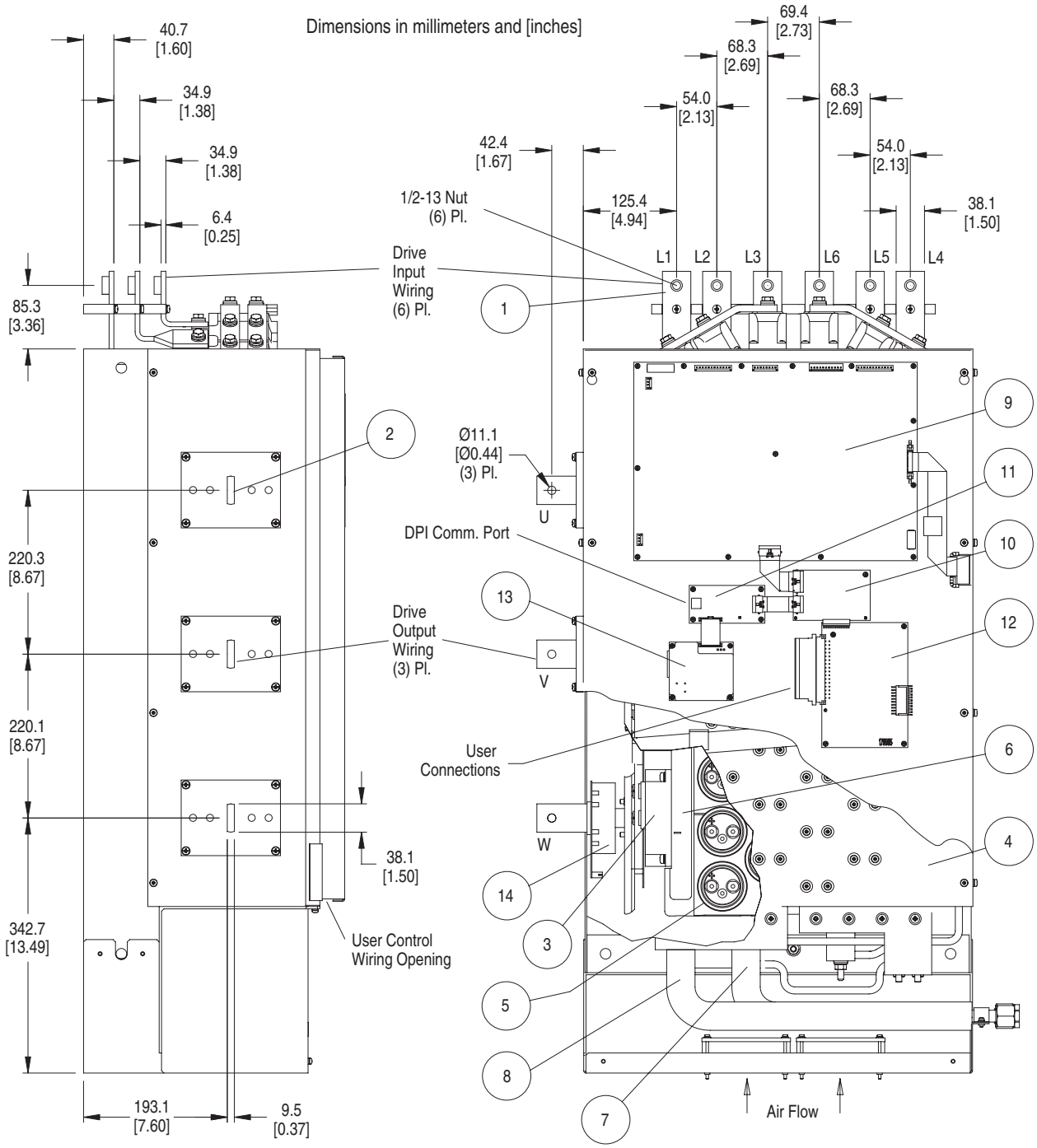
Dimensions in millimeters and [inches]

C-Frame LPM15 Drive Component Locations

The C-Frame LPM15 drives have the following main components. The numbered items listed below correspond to the numbers used in Figure 1.2. Replacement parts are listed in Chapter 4.

1. AC Input Bus Bars (6)
2. AC Output Bus Bars (3)
3. SCR Bridge (AC to DC Converter)
4. Laminated Assembly
5. Capacitors
6. Heatsink
7. Inlet Coolant Connection
8. Outlet Coolant Connection
9. Power Interface Control (PIC) PCB
10. Inverter Control PCB
11. Communication Interface PCB
12. Standard I/O PCB (Optional)
13. Communication Board (Optional)
14. Current Feedback Devices (3)

Figure 1.2 C-Frame LPM15 Drive Component, Wiring, Mounting and Coolant Locations

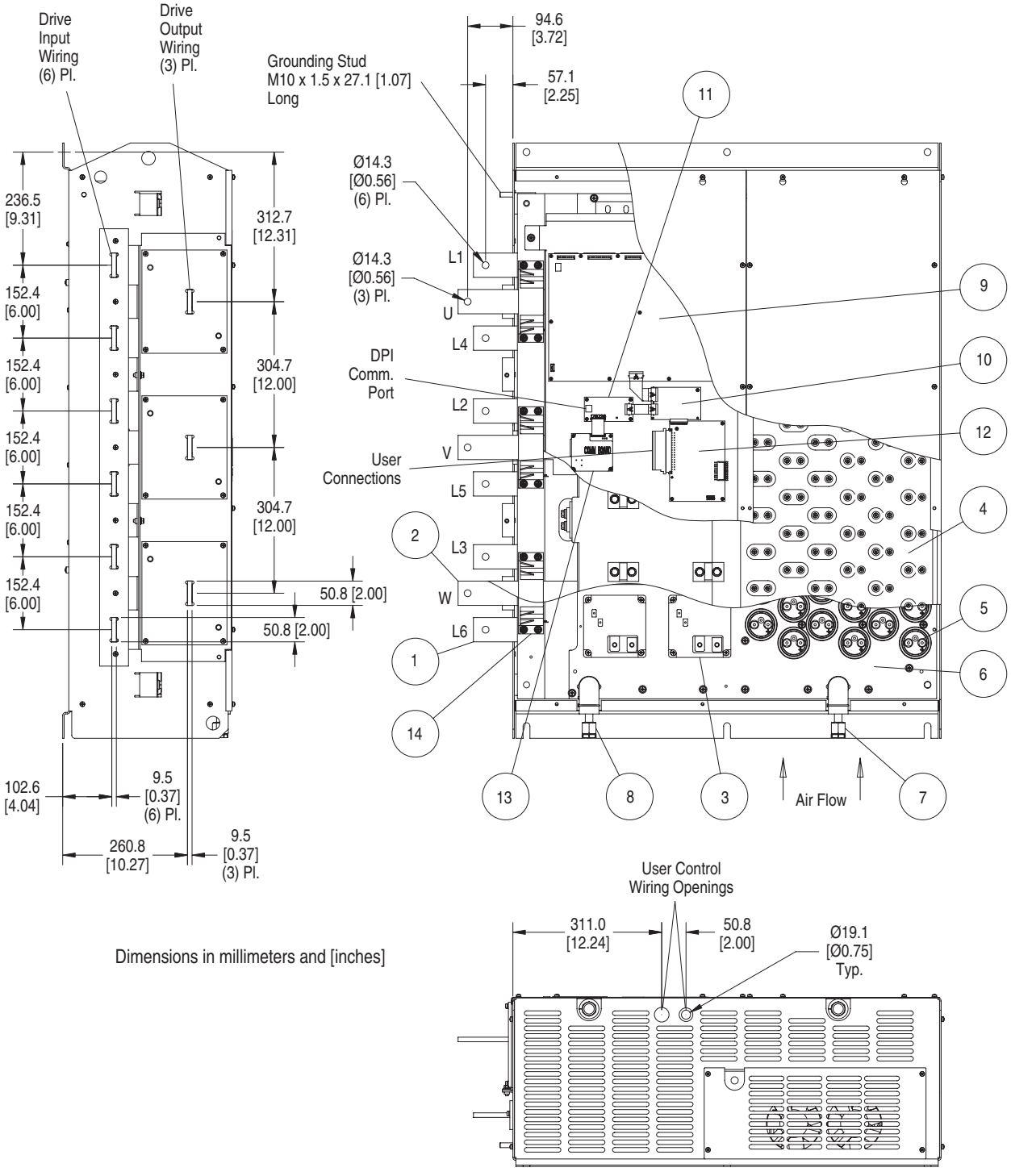


D-Frame LPM15 Drive Component Locations

The D-Frame LPM15 drives have the following main components. The numbered items listed below correspond to the numbers used in Figure 1.3. Replacement parts are listed in Chapter 4.

1. AC Input Bus Bars (6)
2. AC Output Bus Bars (3)
3. IGBT Modules
4. Laminated Assembly
5. Capacitors
6. Heatsink
7. Inlet Coolant Connection
8. Outlet Coolant Connection
9. Power Interface Control (PIC) PCB
10. Inverter Control PCB
11. Communication Interface PCB
12. Standard I/O PCB (Optional)
13. Communication Board (Optional)
14. Current Feedback Devices (3)

Figure 1.3 D-Frame LPM15 Drive Component, Wiring, Mounting and Coolant Locations

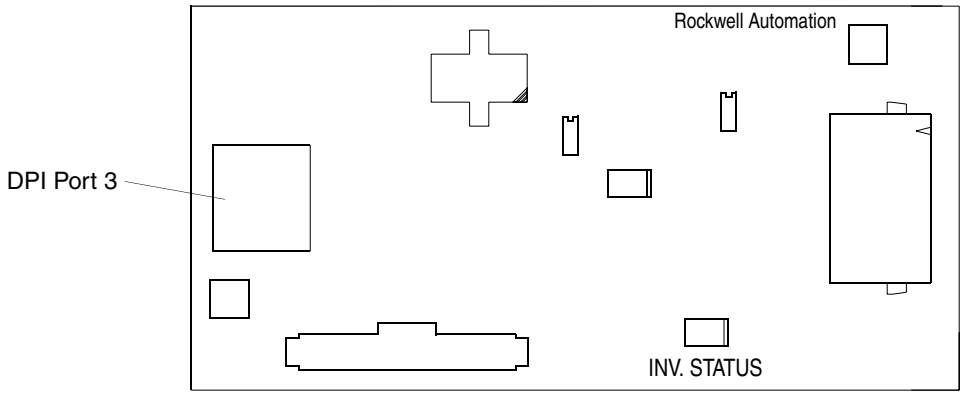


Dimensions in millimeters and [inches]

DPI Communication Port

The Communication Interface PCB contains an eight-position, female, locking mini-DIN connector that is used as a DPI communication port. This port (DPI Port 3 shown in Figure 1.4 below) provides communication between the LPM15 drive and another DPI device (for example, a HIM).

Figure 1.4 DPI Communication Interface Board



For more information regarding operating LPM15 drives with a HIM, refer to Appendix C.

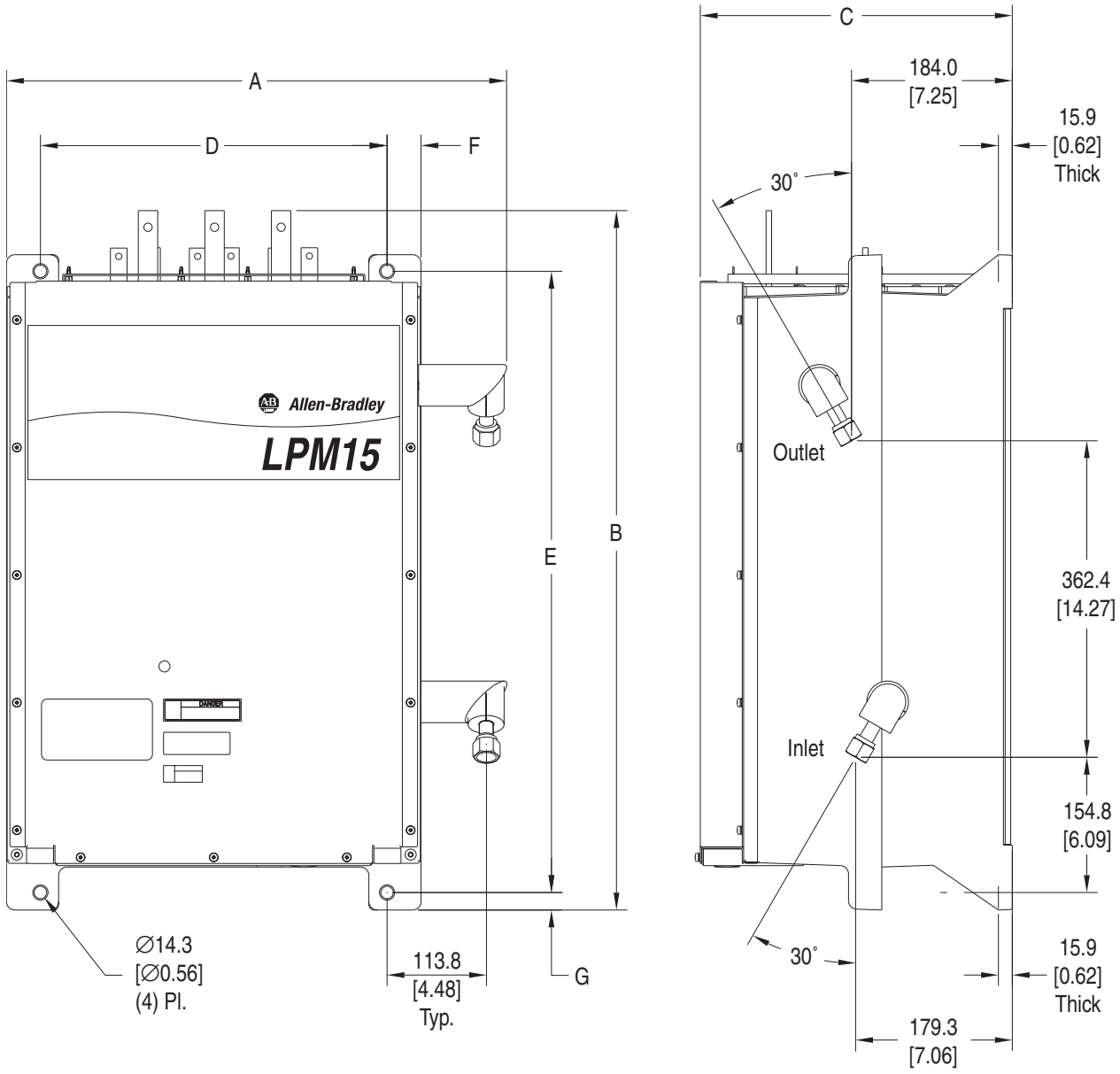
Determining Total Area Required Based on Drive Dimensions

Drive dimensions and weights are listed in Table 1.B. Overall drive dimensions are illustrated in Figure 1.5, Figure 1.6, and Figure 1.7 as an aid in calculating the total area required by the LPM15 drives.

Table 1.B Drive Dimensions and Weights

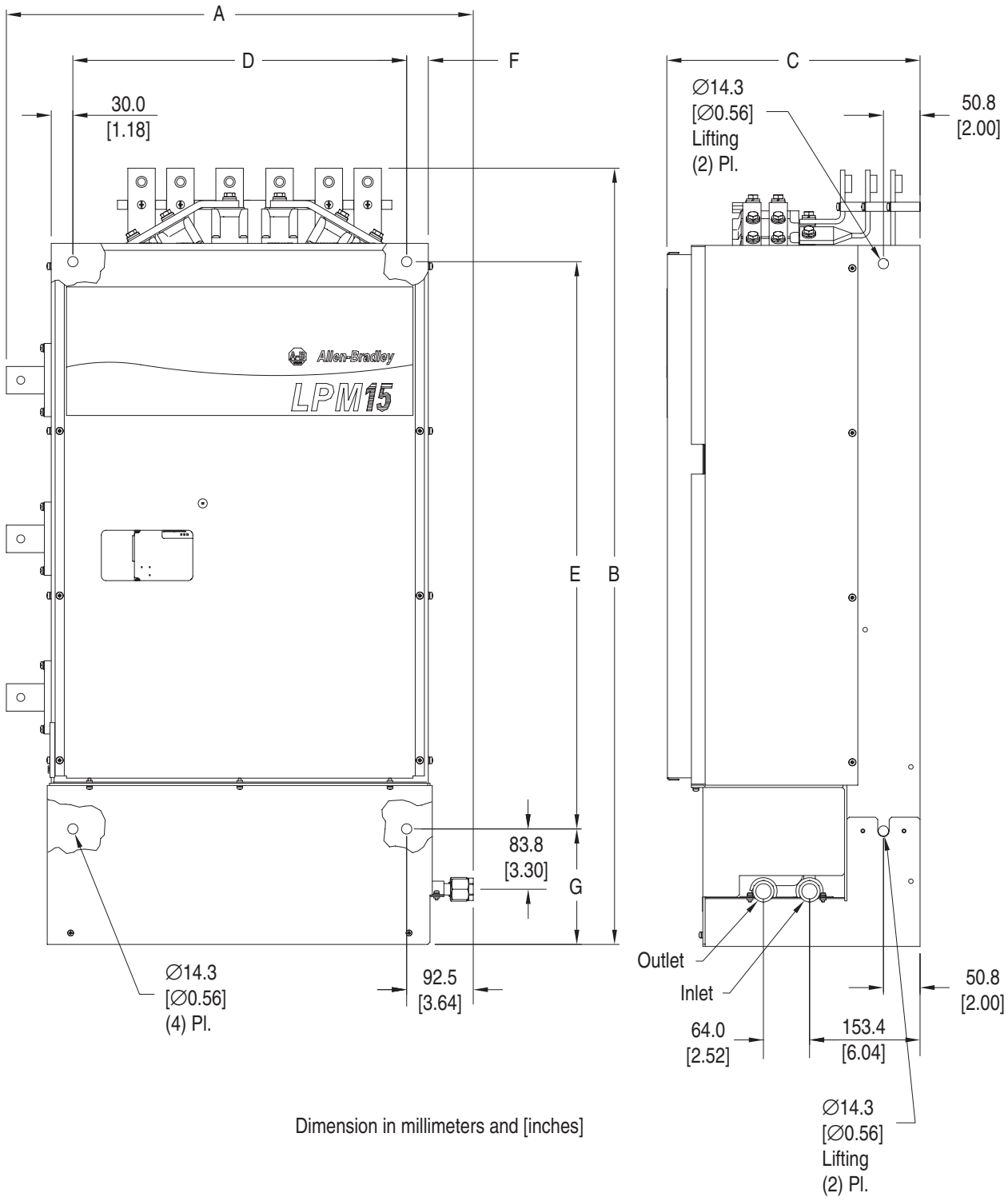
LPM15 Drive Catalog Number (positions 1-7 only)	Frame	Dim. A	Dim. B	Dim. C	Dim. D	Dim. E	Dim. F	Dim. G	Weight
20MD414	B	573 mm 22.54 in	800 mm 31.52 in	357 mm 14.06 in	397 mm 15.63 in	711 mm 28.00 in	39 mm 1.53 in	20 mm 0.79 in	125 kg 275 lb
20MD500	C	648 mm 25.53 in	1078 mm 42.44 in	352 mm 13.86 in	464 mm 18.25 in	787 mm 31.00 in	28 mm 1.09 in	160 mm 6.31 in	171 kg 378 lb
20MD643	C	648 mm 25.53 in	1078 mm 42.44 in	352 mm 13.86 in	464 mm 18.25 in	787 mm 31.00 in	28 mm 1.09 in	160 mm 6.31 in	171 kg 378 lb
20MD1K2	D	1010 mm 39.75 in	1245 mm 49.00 in	360 mm 14.16 in	838 mm 33.00 in	1200 mm 47.25 in	29 mm 1.12 in	25 mm 1.00 in	386 kg 850 lb

Figure 1.5 B-Frame Drive Dimensions



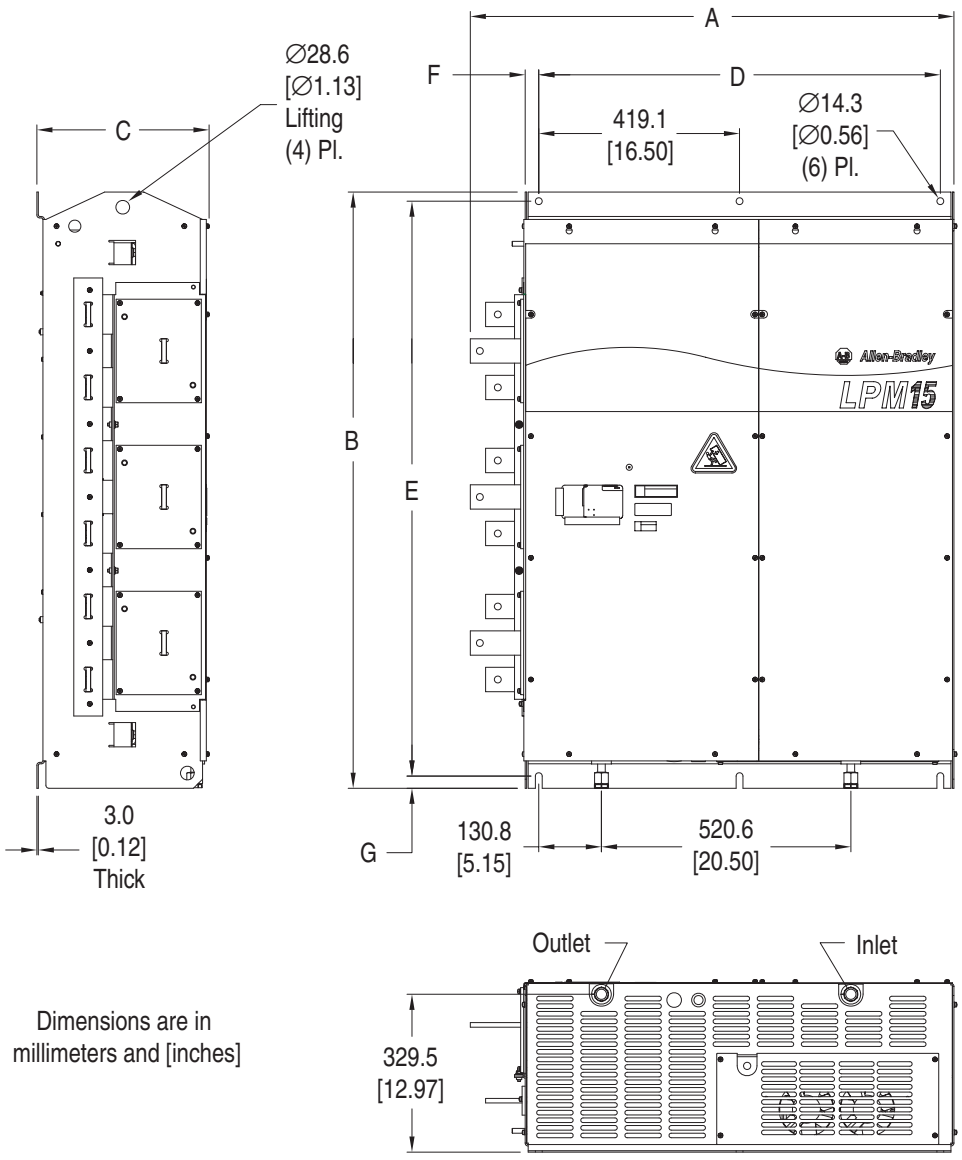
Dimensions in millimeters and [inches]

Figure 1.6 C-Frame Drive Dimensions



Dimension in millimeters and [inches]

Figure 1.7 D-Frame Drive Dimensions



Verifying the Site Provides for Recommended Air Flow Clearances

Be sure there is adequate clearance for air circulation around the user-supplied enclosure. A 6-inch minimum clearance is required wherever vents are located in the cabinet.

Verifying Power Module Input Ratings Match Supplied Power

It is important to verify that plant power will meet the input power requirements of the LPM15 drive's Power Module circuitry. See Table 1.A for input power rating specifications. Be sure input power to the drive corresponds to the drive nameplate voltage and frequency.

AC Supply Source Considerations

LPM15 drives are suitable for use on a circuit capable of delivering up to a maximum of 85,000 rms symmetrical amperes, and a maximum of 480 volts. A circuit breaker with the appropriate KAIC rating needs to be used upstream of the drive.

ATTENTION: To guard against personal injury and/or equipment damage caused by improper fusing or circuit breaker selection, use only the recommended line fuses/circuit breakers specified in Table 1.C.

Unbalanced or Ungrounded Distribution Systems

LPM15 drives should not be used with a supply system that is ungrounded and when the phase-to-phase voltage exceeds 125% of normal line-to-line voltage.

ATTENTION: LPM15 drives contain protective MOVs on the drive's printed circuit boards. The MOVs are referenced to ground. The MOVs cannot be disconnected. The LPM15 drives do not contain common mode capacitors.

Input Power Conditioning

Certain events on the power system supplying a drive can cause component damage or shortened product life. They are:

- The power system has power factor correction capacitors switched in and out of the system, either by the user or by the power company.
- The power source has intermittent voltage spikes in excess of 6000 volts. These spikes could be caused by other equipment on the line or by events such as lightning strikes.
- The power source has frequent interruptions.

Wiring Requirements for the Drive

Certain drive requirements should be checked before continuing with the drive installation. Wire sizes, branch circuit protection, and E-stop wiring are all areas that need to be evaluated.

Selecting Input Line Branch Circuit Fuses

ATTENTION: Most codes require that upstream branch circuit protection be provided to protect input power wiring. Install the fuses recommended in Table 1.C. Do not exceed the fuse ratings. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Input line branch circuit protection fuses must be used to protect the input power lines. See Figure 1.9 and Figure 1.10 for typical AC input/output connection diagrams. Recommended fuse values are shown in Table 1.C. The listed input fuse ratings are applicable for one drive per branch circuit. No other load may be applied to that fused circuit.

Table 1.C AC Input Line Fuse and Circuit Breaker Selection Values

LPM15 Drive Catalog Number (positions 1-7 only)	Input Voltage (+/-10%)	Fuse Rating	Motor Circuit Protector or Circuit Breaker
20MD414	380-480 VAC	600 A(1)	600 A
20MD500	380-480 VAC	750 A(2)	800 A
20MD643	380-480 VAC	1000 A(1)	1000 A
20MD1K2	380-480 VAC	1600 A(2)	1500 A

(1) Recommended fuse type: UL Class J, 600 V, time-delay, or equivalent.

(2) Recommended fuse type: UL Class L, 600 V, time-delay, or equivalent.

Fuses and Circuit Breakers

The LPM15 can be installed with either input fuses or an input circuit breaker. National and local industrial safety regulations and/or electrical codes may determine additional requirements for these installations. Refer to Table 1.C for recommended fuses/circuit breakers.

ATTENTION: The LPM15 does not provide branch short circuit protection. Specifications for the recommended fuse or circuit breaker to provide protection against short circuits are provided in Table 1.C.

Mounting the Drive, Determining Wire Routing, and Grounding

This chapter shows how to mount the drive and properly ground it. Also described is the wiring to be routed in and out of the drive.

Lifting and Mounting the Drive

Use the following procedure to lift the LPM15 drive and mount it in the required enclosure:

1. **For Cat. # 20MD414,** install two clevis clamps into the drive to serve as lifting points. Two 9/16-inch through holes are machined into the casting protrusions.

   For Cat. # 20MD500 or 20MD643, install two eyebolts into the drive to serve as lifting points. Two 3/4-inch nuts are welded to the drive's baseplate. Screw two eyebolts (2-inch eye I.D., 6-inch long shank) into the nuts.

   For Cat. # 20MD1K2, install two clevis pins into the drive to serve as lifting points. Two 1-inch through holes are provided in the sheet metal chassis.

2. **For Cat. # 20MD414, 20MD500 or 20MD643,** connect 18 inches (nominal) of chain between the eyebolts or attached clevis clamps and secure them with a clevis clamp.

   For Cat. # 20MD1K2, connect 50 inches (nominal) of chain between the eyebolts or attached clevis clamps and secure them with a clevis clamp.

3. Using an overhead or portable hoist (minimum 1/2-ton rated capacity), attach a free-fall chain to the chain secured to the drive. Take up any vertical slack in the chain.

4. Using the hoist, lift the drive from the horizontal shipping pallet.

5. Position the drive in the enclosure.

6. **For Cat. # 20MD414, 20MD500 or 20MD643,** attach the drive to the vertical surface selected using the four (4) mounting holes provided.

   For Cat. # 20MD1K2, attach the drive to the vertical surface using the six (6) mounting holes provided.

   In order to maintain a flat mounting surface and to ensure that bolt tightness is maintained, use flat washers and split-ring lock washers under the bolt heads. Refer to Table 1.B and Figure 1.5, Figure 1.6 or Figure 1.7 for drive mounting dimensions.

7. **For Cat. # 20MD500 or 20MD643**, remove the eyebolts and the chain between them.

   For Cat. # 20MD414 or 20MD1K2, remove the clevis clamps and chain between them.

Verifying the Drive's Watts Loss Rating

When mounting the drive inside of an enclosure, you should determine the watts loss rating of the drive from Table 1.A. This table lists the typical full load power loss watts value at 2 kHz (rated carrier frequency). Ensure that the enclosure is adequately ventilated with 0° to 40° C ambient air based on the drive's watts loss rating.

Determining Input, Motor Output, Ground, and Control Wire Routing for the Drive

All wiring should be installed in conformance with the applicable local, national, and international codes (e.g., NEC/CEC). Signal wiring, control wiring, and power wiring must be routed in separate conduits to prevent interference with drive operation. Use grommets, when hubs are not provided, to guard against wire chafing. Figure 1.1, Figure 1.2, and Figure 1.3 show the wire routing, grounding terminal, and power terminal strips of the B-frame, C-frame, and D-frame LPM15 drives.

ATTENTION: Do not route signal and control wiring with power wiring in the same conduit. This can cause interference with drive operation. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Do not route more than three sets of motor leads through a single conduit. This will minimize cross-talk that could reduce the effectiveness of noise reduction methods. If more than three drive/motor connections per conduit are required, shielded cable must be used. If possible, each conduit should contain only one set of motor leads.

ATTENTION: Unused wires in conduit must be grounded at both ends to avoid a possible shock hazard caused by induced voltages. Also, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled to eliminate the possible shock hazard from cross-coupled motor leads. Failure to observe these precautions could result in bodily injury.

Grounding the Drive

ATTENTION: The user is responsible for conforming with all applicable local, national, and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Use the following steps to ground the drive:

1. Open the door of the enclosure.
2. Run a suitable equipment grounding conductor unbroken from the drive to the motor's ground terminal and then to earth ground. For B- and C-frame drives, use one of the bolts that pass through the drive baseplate and are used to fasten the drive to the wall or cabinet. For D-frame drives, use the ground stud provided. See Figure 1.1, Figure 1.2 or Figure 1.3. Tighten these grounding connections to the proper torque as shown in Table 1.E.

3. Connect a suitable grounding conductor to the motor frame and the remote control station (if used). Run each conductor unbroken to earth ground. When adding more than one grounding conductor wire to a single chassis ground, twist the conductors together. Tighten these grounding connections to the proper torque as shown in Table 1.E.

4. Close the door of the enclosure.

Coolant Considerations

LPM15 drives use o-ring face seal fittings for connection to the coolant supply. The coolant is typically clean water with a corrosion inhibitor as described in this section.

Considerations Affecting all Frame Sizes

LPM15 drive coolant connections are made with o-ring face seal fittings. The copper tube running from the heatsink to the o-ring fittings is covered with closed cell foam insulation.

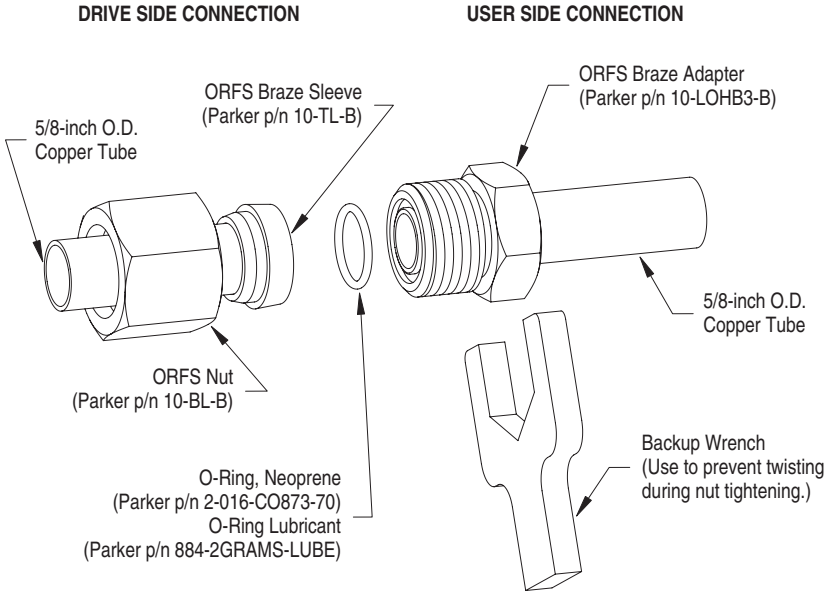
The mating connection is shown in Figure 1.8. The mating process includes the following steps:

1. Coat the o-ring with the o-ring lubricant. The goal is a thin film covering the entire o-ring surface. Avoid excess globs of lubricant.

2. Insert the o-ring into the o-ring groove in the external thread-side fitting on the user side. Avoid any twisting of the o-ring.

3. Assemble the fittings and tighten to a torque of 37 to 45 N-m (or 27 to 33 lb.-ft.). Use a backup wrench on the user side fitting to avoid twisting the drive side tubing.

Figure 1.8 Mating Connection



Other recommendations include:

1. The allowable coolant temperature range is 4°C to 40°C (40°F to 105°F). When using coolant at a temperature below the dew point of the surrounding air, condensation could accumulate on the drive heatsink and/or circuit boards and damage the drive. In this situation, install a coolant flow regulating device and tube/hose insulation. A flow regulating device modulates the coolant flow rate to a level that permits the drive heatsink temperature to rise above the dew point. Insulation for customer side tube or hose may be closed-cell foam insulation with minimum 1/2-inch wall thickness.
2. Install a flow switch after the coolant outlet connection to shutoff the drive if coolant flow drops below 4 gpm.
3. Circulate water through the drive only when the drive is also powered. Failure to do this may result in condensation accumulating on the drive heatsink and/or circuit boards, which could damage the drive.
4. For applications requiring a closed loop coolant system, ensure the system is vented to remove air that would otherwise degrade the performance of the drive heatsink.

B-Frame Coolant Connections

B-frame LPM15 drives have inlet and outlet connections as shown in Figure 1.1. O-ring fittings and copper tube are brazed to copper tubes protruding from the heatsink.

Supply and return lines should be sized for 9 gpm/120 psi service with a maximum operating temperature of 40°C (104°F). Actual operating flow rate through the drive is 8 gpm with a pressure drop of 10 psi.

C-Frame Coolant Connections

C-frame LPM15 drives have inlet and outlet connections as shown in Figure 1.2 O-ring fittings and copper tube are brazed to copper tubes protruding from the heatsink.

Supply and return lines should be sized for 5 gpm/120 psi service with a maximum operating temperature of 40°C (104°F). Actual operating flow rate through the drive is 5 gpm with a pressure drop of 30 psi.

D-Frame Coolant Connections

D-frame LPM15 drives have inlet and outlet connections as shown in Figure 1.3. O-ring fittings and copper tube are bolted to the heatsink via a two-bolt-hole flange and compressed fiber gasket.

Supply and return lines should be sized for 8 gpm/120 psi service with a maximum operating temperature of 40°C (104°F). Actual operating flow rate through the drive is 8 gpm with a pressure drop of 10 psi.

The D-frame drive inlet pressure must not exceed 50 psi. A pressure regulator, pressure switch, or pressure relief device is required to limit drive inlet pressure below 50 psi under all normal and abnormal operating conditions.

ATTENTION: Operating the D-Frame drive at a pressure greater than 50 psi will permanently damage the equipment.

Coolant Requirements

LPM15 drives are rated for use with coolant consisting of clean water with a corrosion inhibitor. Deionized water is prohibited. Use distilled water or water with the following concentrations:

- Less than 50 ppm of sulfate and chloride.
- Less than 50 ppm of hard water ions such as Mg++ and Ca++.

Coolant must be properly strained and/or filtered to ensure it is free of contamination.

The coolant must be compatible with the following materials: Copper, brass, aluminum, and neoprene. For the D-frame drive only, the coolant must be compatible with Loctite 587 Ultra Blue® RTC silicone rubber.

Ultra Blue is a registered trademark of Loctite Corporation.

Corrosion Inhibitor

A corrosion inhibitor is required. The following two options are approved sources:

1. Chemtool, Inc. (www.chemtool.com) Watertool 4435-C. The recommended concentration of the inhibitor is 8 to 10% by volume.
2. Dow Chemical (www.dow.com) Dowtherm® SR-1 inhibited ethylene glycol. The recommended concentration of the inhibitor is 25% by volume.

Dowtherm is a registered trademark of the Dow Chemical Company.

ATTENTION: Ethylene glycol must be inhibited and silicate free. Use of common silicate-containing, automotive-type ethylene glycol solutions is prohibited as they may damage the drive and cooling module equipment.

If ethylene glycol is used, the recommended coolant flow rates should be according to Table 1.D.

Table 1.D Recommended Coolant Flow Rates with 25% Ethylene Glycol

Frame	Flowrate (GPM)	Pressure Drop From Drive Inlet to Drive Outlet (PSIG)
B	11	25
C	8	70
D	11	25

Biocide

A biocide may be needed to control biological growth. Use of a biocide is permitted. For specific recommendations, consult a reputable water treatment company.

Installing Input Power Wiring

This section describes incoming line components and how to install them.

Installing Transformers and Reactors (Optional)

The LPM15 AC drive may be used on distribution systems with 85,000 amps or less symmetrical fault current capacity. Line reactors are not needed for safe operation of the drive but may be required to reduce line harmonics.

Input isolation transformers might be needed to help eliminate:

- Damaging line voltage transients from reaching the drive.
- Line noise from the drive back to the incoming power source.
- Damaging currents that could develop if a point inside the drive becomes grounded.

Observe the following guidelines when installing an isolation transformer:

- A power-disconnecting device must be installed between the power line and the primary of the transformer.
- If the power-disconnecting device is a circuit breaker, the circuit breaker trip rating must be coordinated with the in-rush current (10 to 12 times full load current) of the transformer.

Installing Fuses for Branch Circuit Protection

Install the required, user-supplied branch circuit protection fuses according to the applicable local, national, and international codes (e.g., NEC/CEC). The fuses must be installed in the line before the drive input terminals. See Figure 1.9 or Figure 1.10. Fuse value selections are provided in Table 1.C.

ATTENTION: Most codes require that upstream branch protection be provided to protect input power wiring. Failure to observe this precaution could result in severe bodily injury or loss of life.

Figure 1.9 Typical AC Input/Output Electrical Connections (6-Pulse Rectifier, All Frames)

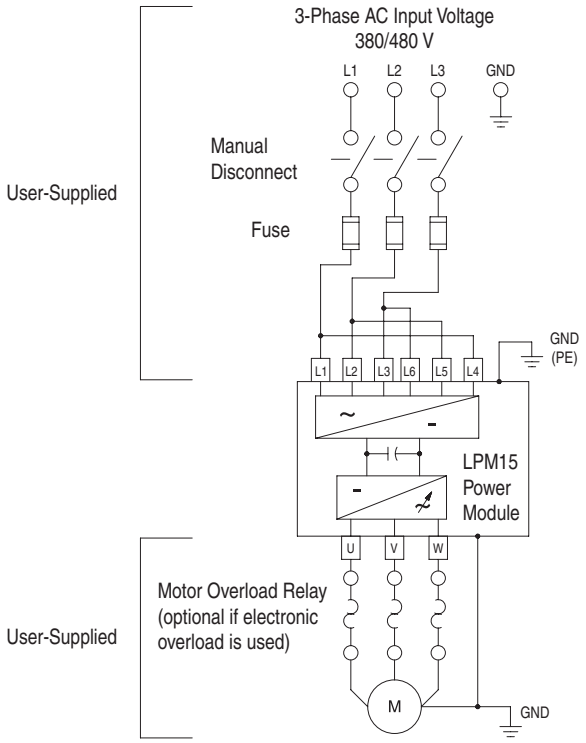
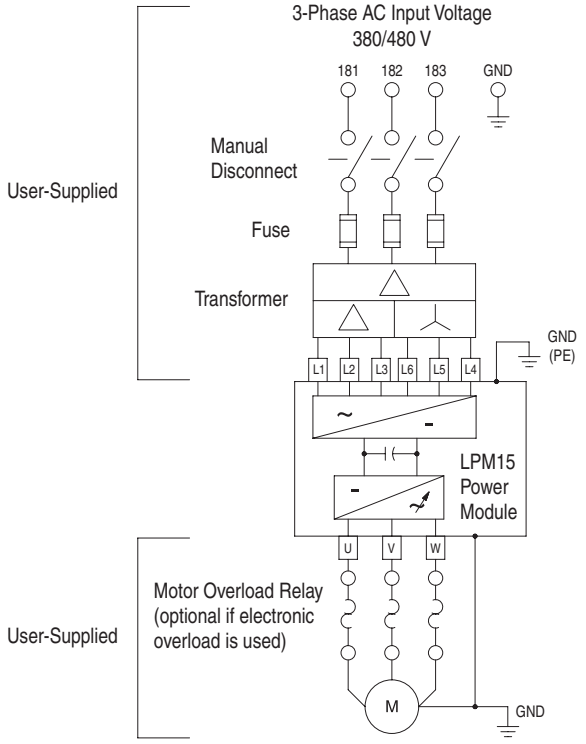


Figure 1.10 Typical AC Input/Output Electrical Connections (12-Pulse Rectifier, B- and C-Frames Only)



Installing a Required External/Separate Input Disconnect

An input disconnect must be installed in the line before the drive input terminals in accordance with local, national, and international codes (e.g., NEC/CEC). The disconnect should be sized according to the in-rush current as well as any additional loads the disconnect might supply. The trip rating for the inrush current (10-12 times full load current) should be coordinated with that of the input isolation transformer, if used. Refer to Installing Transformers and Reactors (Optional) on page 1-19 for additional information.

Installing Power Wiring from the AC Input Line to the Drive's Power Terminals

Use the following steps to connect AC input power to the drive:

1. Wire the AC input power leads by routing them as shown in Figure 1.1, Figure 1.2 or Figure 1.3.

ATTENTION: Do not route signal and control wiring with power wiring in the same conduit. This can cause interference with drive operation. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

2. Connect the three-phase AC input power leads (three-wire 380-480 VAC) to the appropriate terminals.

   On 6-pulse rectifier drives, connect the AC input power leads to the L1, L2, and L3 terminals. See Figure 1.9.

   On 12-pulse rectifier drives, connect the AC input power leads to the L1, L2, L3, L4, L5, and L6 terminals. See Figure 1.10.

3. Tighten the AC input power terminals to the proper torque as shown in Table 1.E.

Table 1.E Terminal Tightening Torques

Drive Type	Terminals	Hardware Type	Maximum Tightening Torque (±10%)
B-Frame	L1 to L6	1/4-20, Gr. 5	13 N-m (10 lb.-ft.)
	U, V, W	5/16-18, Gr. 5	24 N-m (18 lb.-ft.)
	GND, PE	5/16 Hex	31 N-m (23 lb.-ft.)
C-Frame	L1 to L6	1/2-13; Gr. 5	100 N-m (75 lb.-ft.)
	U, V, W	3/8-16, Gr. 5	42 N-m (31 lb.-ft.)
	GND, PE	5/16 Hex	31 N-m (23 lb.-ft.)
D-Frame	L1 to L6	1/2-13; Gr. 5	100 N-m (75 lb.-ft.)
	U, V, W	1/2-13; Gr. 5	100 N-m (75 lb.-ft.)
	GND, PE	1/2 Hex	58 N-m (42 lb.-ft.)

Installing Output Power Wiring

This section provides instructions on wiring output contactors, motor overload protection, and output wiring to the motor.

Installing Mechanical Motor Overload Protection (Optional)

To provide the motor with overload protection, local, national, and international codes (e.g., NEC/CEC) may require one of the following:

- a motor thermostat be installed internal to the motor.
- a mechanical thermal motor overload relay, sized to protect the motor, be installed between the motor and the drive's output terminals.

In multiple motor applications (V/Hz regulation only), each motor must have its own user-supplied overload and branch circuit protection.

Installing Output Wiring from the Drive Output Terminals to the Motor

Important: The total motor lead length must not exceed 76 meters (250 feet).

Use the following steps to connect the AC output power wiring from the drive to the motor:

1. Wire the three-phase AC output power motor leads by routing them as shown in Figure 1.1, Figure 1.2 or Figure 1.3.

   Do not route more than three sets of motor leads through a single conduit. This will minimize cross-talk that could reduce the effectiveness of noise reduction methods. If more than three drive/motor connections per conduit are required, shielded cable must be used. If possible, each conduit should contain only one set of motor leads.

ATTENTION: Do not route signal and control wiring with power wiring in the same conduit. This can cause interference with drive operation. Failure to observe these precautions could result in damage to, or destruction of, the equipment

ATTENTION: Unused wires in conduit must be grounded at both ends to avoid a possible shock hazard caused by induced voltages. Also, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled to eliminate the possible shock hazard from cross-coupled motor leads. Failure to observe these precautions could result in bodily injury.

2. Connect the three-phase AC power motor leads to the appropriate output terminals. Figure 1.1, Figure 1.2, or Figure 1.3 show the locations of the output power terminals.

3. Tighten the three-phase AC output power terminals to the proper torque as shown in Table 1.E.

Power Wiring

ATTENTION: National Codes and standards (NEC, VDE, BSI etc.) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, branch circuit protection, and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

Cable Types Acceptable for 200-600 Volt Installations

A variety of cable types are acceptable for drive installations. For many installations, unshielded cable is adequate, provided it can be separated from sensitive circuits. As an approximate guide, allow a spacing of 0.3 meters (1 foot) for every 10 meters (32.8 feet) of length. In all cases, long parallel runs must be avoided. Do not use cable with an insulation thickness less than or equal to 15 mils (0.4 mm/0.015 in.). Use Copper wire only. Wire gauge requirements and recommendations are based on 75 degrees C. Do not reduce wire gauge when using higher temperature wire.

Unshielded

THHN, THWN or similar wire is acceptable for drive installation in dry environments provided adequate free air space and/or conduit fill rates limits are provided. **Do not use THHN or similarly coated wire in wet areas**. Any wire chosen must have a minimum insulation thickness of 15 mils and should not have large variations in insulation concentricity.

ATTENTION: To avoid a possible shock hazard caused by induced voltages, unused wires in the conduit must be grounded at both ends. For the same reason, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled. This will help minimize the possible shock hazard from “cross coupled” motor leads.

Using Input/Output Contactors

Input Contactor Precautions

ATTENTION: A contactor or other device that routinely disconnects and reapplies the AC line to the drive to start and stop the motor can cause drive hardware damage. The drive is designed to use control input signals that will start and stop the motor. If an input device is used, operation must not exceed one cycle per minute or drive damage will occur.

ATTENTION: The drive start/stop/enable control circuitry includes solid state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit may be required to remove the AC line to the drive. An auxiliary braking method may be required.

Output Contactor Precaution

ATTENTION: To guard against drive damage when using output contactors, the following information must be read and understood. One or more output contactors may be installed between the drive and motor(s) for the purpose of disconnecting or isolating certain motors/loads. If a contactor is opened while the drive is operating, power will be removed from the respective motor, but the drive will continue to produce voltage at the output terminals. In addition, reconnecting a motor to an active drive (by closing the contactor) could produce excessive current that may cause the drive to fault. If any of these conditions are determined to be undesirable or unsafe, an auxiliary contact on the output contactor should be wired to a drive digital input that is programmed as “Enable.” This will cause the drive to execute a coast-to-stop (cease output) whenever an output contactor is opened.

I/O Wiring

Important points to remember about I/O wiring:

- Use Copper wire only. Wire gauge requirements and recommendations are based on 75 degrees C. Do not reduce wire gauge when using higher temperature wire.
- Wire with an insulation rating of 600V or greater is recommended.
- Control and signal wires should be separated from power wires by at least 0.3 meters (1 foot).

Important: I/O terminals labeled "(–)" or "Common" are not referenced to earth ground and are designed to greatly reduce common mode interference. Grounding these terminals can cause signal noise.

ATTENTION: Configuring an analog input for 0-20mA operation and driving it from a voltage source could cause component damage. Verify proper configuration prior to applying input signals.

ATTENTION: Hazard of personal injury or equipment damage exists when using bipolar input sources. Noise and drift in sensitive input circuits can cause unpredictable changes in motor speed and direction. Use speed command parameters to help reduce input source sensitivity.

Signal and Control Wire Types

Table 1.F Recommended Signal Wire

Signal Type/ Where Used	Wire Type(s)	Description	Minimum Insulation Rating
Standard Analog I/O	Belden 8760/9460 (or equiv.)	0.750 mm^2 (18 AWG), twisted pair, 100% shield with drain (1)	300V, 75-90°C (167-194°F)
Remote Pot	Belden 8770 (or equivalent)	0.750 mm^2 (18 AWG), 3 cond., shielded	

(1) If the wires are short and contained within a cabinet which has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

Table 1.G Recommended Control Wire for Digital I/O

Type	Wire Type(s)	Description	Minimum Insulation Rating
Unshielded	Per US NEC or applicable national or local code	—	300V, 60°C (140°F)
Shielded	Multi-conductor shielded cable such as Belden 8770 (or equivalent)	0.750 mm^2 (18 AWG), 3 conductor, shielded.	

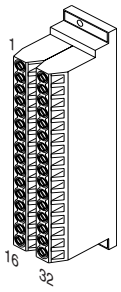
I/O Terminal Blocks

Table 1.H I/O Terminal Block Specifications

Name	Description	Wire Size Range[1]		Torque	
		Maximum	Minimum	Maximum	Recommended
I/O Terminal Block	Signal and control connections	2.1 mm^2 (14 AWG)	0.30 mm^2 (22 AWG)	0.6 N-m (5.2 lb.-in.)	0.6 N-m (5.2 lb.-in.)

[1] Maximum/minimum that the terminal block will accept - these are not recommendations.

Figure 1.11 Control Option I/O Terminal Designations



Standard Control Option	No.	Signal	Factory Default	Description	Related Param.
	1	Anlg Volts In 1 (–)	[2]	Isolated[3], bipolar, differential, ± 10V, 11 bit & sign, 88k ohm input impedance.	320 - 327
	2	Anlg Volts In 1 (+)			
	3	Anlg Volts In 2 (–)	[2]	Isolated[4], bipolar, differential, ±10V, 11 bit & sign, 88k ohm input impedance.	
	4	Anlg Volts In 2 (+)			
	5	Pot Common	—	For (+) and (–) 10V pot references.	
	6	Anlg Volts Out 1 (–)	[2]	Bipolar, ±10V, 11 bit & sign, 2k ohm minimum load.	340 - 344
	7	Anlg Volts Out 1 (+)			
	8	Anlg Current Out 1 (–)	[2]	4-20 mA, 11 bit & sign, 400 ohm maximum load.	
	9	Anlg Current Out 1 (+)			
	10	Reserved for Future Use			
	11	Digital Out 1 – N.C.[1]	Fault	Max. Resistive Load: 240V AC/30V DC – 1200VA, 150W Max. Current: 5A, Min. Load: 10 mA Max. Inductive Load: 240V AC/30V DC – 840VA, 105W Max. Current: 3.5A, Min. Load: 10mA	380 - 387
	12	Digital Out 1 Common			
	13	Digital Out 1 – N.O.[1]	NOT Fault		
	14	Digital Out 2 – N.C.[1]	NOT Run		
	15	Digital Out 2 Common			
	16	Digital Out 2 – N.O.[1]	Run		
	17	Anlg Current In 1 (–)	[2]	Isolated[3], 4-20 mA, 11 bit & sign, 124 ohm input impedance.	320 - 327
	18	Anlg Current In 1 (+)			
	19	Anlg Current In 2 (–)	[2]	Isolated[4], 4-20 mA, 11 bit & sign, 124 ohm input impedance.	
	20	Anlg Current In 2 (+)			
	21	–10V Pot Reference	—	2k ohm minimum.	
	22	+10V Pot Reference	—		
	23	Reserved for Future Use			
	24	+24VDC[5]	—	Drive supplied logic input power.[5]	
	25	Digital In Common	—		
	26	24V Common[5]	—	Common for internal power supply.	
	27	Digital In 1	Stop - CF	<u>115V AC, 50/60 Hz</u> - Opto isolated Low State: less than 30V AC High State: greater than 100V AC <u>24V AC/DC, 50/60 Hz</u> - Opto isolated Low State: less than 5V AC/DC High State: greater than 20V AC/DC, 11.2 mA DC	361 - 366
	28	Digital In 2	Start		
	29	Digital In 3	Jog		
	30	Digital In 4	Speed Sel 1		
	31	Digital In 5	Speed Sel 2		
	32	Digital In 6	Speed Sel 3		

[1] Contacts in unpowered state. Any relay programmed as Fault or Alarm will energize (pick up) when power is applied to drive and deenergize (drop out) when a fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will deenergize when condition is removed.

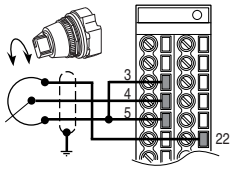
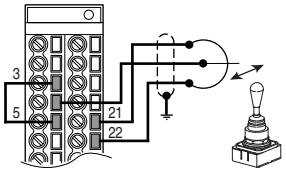
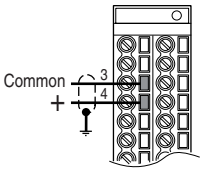
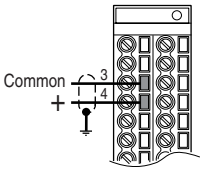
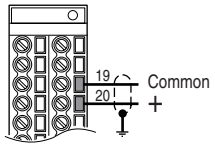
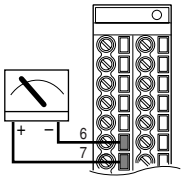
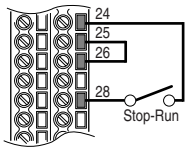
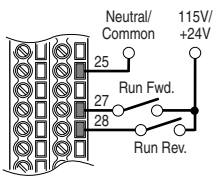
[2] These inputs/outputs are dependant on a number of parameters. See “Related Parameters.”

[3] Differential Isolation - External source must be maintained at less than 160V with respect to PE. Input provides high common mode immunity.

[4] Differential Isolation - External source must be less than 10V with respect to PE.

[5] 150 mA maximum Load. Not present on 115V versions.

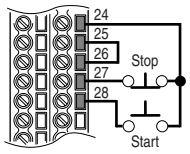
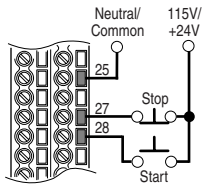
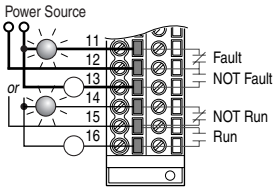
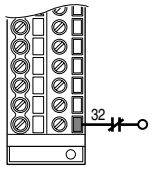
I/O Wiring Examples

Input/Output	Connection Example	Required Parameter Changes
Potentiometer Unipolar Speed Reference(1) 10k Ohm pot. recommended (2k Ohm minimum)		• Adjust Scaling: Parameters 91/92 and 325/326 • View Results: Parameter 002
Joystick Bipolar Speed Reference(1) ± 10V Input		• Set Direction Mode: Parameter 190 = “1, Bipolar” • Adjust Scaling: Parameters 91/92 and 325/326 • View Results: Parameter 002
Analog Input Bipolar Speed Reference ± 10V Input		• Set Direction Mode: Parameter 190 = “1, Bipolar” • Adjust Scaling: Parameters 91/92 and 325/326 • View Results: Parameter 002
Analog Voltage Input Unipolar Speed Reference 0 to +10V Input		• Configure Input with Parameter 320 • Adjust Scaling: Parameters 91/92 and 325/326 • View results: Parameter 002
Analog Current Input Unipolar Speed Reference 4-20 mA Input		• Configure Input for Current: Parameter 320, Bit 1 = “1, Current” • Adjust Scaling: Parameters 91/92 and 325/326 • View Results: Parameter 002
Analog Output ± 10V, 4-20 mA Bipolar + 10V Unipolar *(shown)* 4-20 mA Unipolar *(use terminals 8 and 9)*		• Configure with Parameter 340 • Select Source Value: Parameter 384, [Digital Out1 Sel] • Adjust Scaling: Parameters 343/344
2-Wire Control Non-Reversing (2) 24V DC internal supply		• Disable Digital Input:#1: Parameter 361 = “0, Unused” • Set Digital Input #2: Parameter 362 = “7, Run” • Set Direction Mode: Parameter 190 = “0, Unipolar”
2-Wire Control Reversing (2) External supply (I/O Board dependent)		• Set Digital Input:#1: Parameter 361 = “8, Run Forward” • Set Digital Input #2: Parameter 362 = “9, Run Reverse”

(1) Refer to the Attention statement on page 1-25 for important bipolar wiring information.

(2) **Important:** Programming inputs for 2 wire control deactivates all HIM Start buttons.

I/O Wiring Examples (continued)

Input/Output	Connection Example	Required Parameter Changes
3-Wire Control Internal supply		• No Changes Required
3-Wire Control External supply (I/O Board dependent). Requires 3-wire functions only ([Digital In1 Sel]). Using 2-wire selections will cause a type 2 alarm.		• No Changes Required
Digital Output Relays shown in powered state with drive faulted. See page 1-26.		• Select Source to Activate: Parameters 380/384
Enable Input		• Set Parameter P366 to “1” (Enable).

Reference Control

“Auto” Speed Sources

The drive speed command can be obtained from a number of different sources. The source is determined by drive programming and the condition of the Speed Select digital inputs, Auto/Manual digital inputs, or reference select bits of a command word.

The default source for a command reference (all speed select inputs open or not programmed) is the selection programmed in [Speed Ref A Sel]. If any of the speed select inputs are closed, the drive will use other parameters as the speed command source.

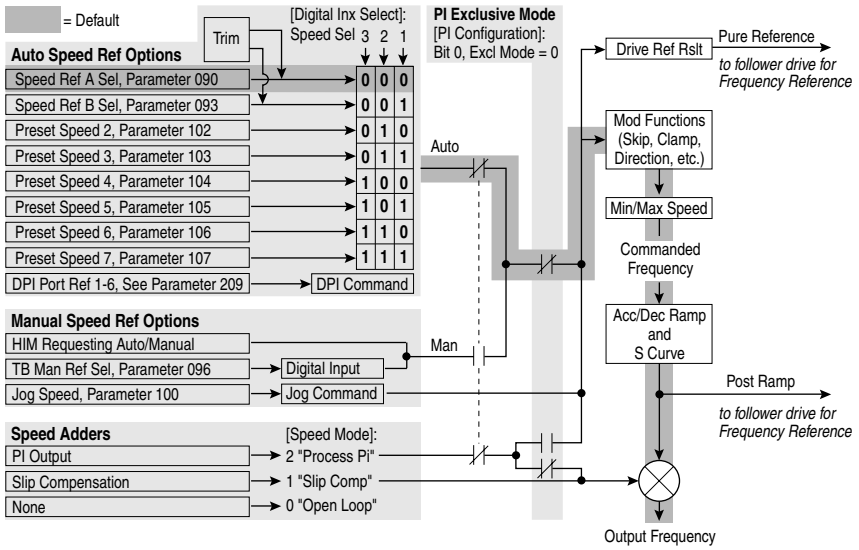
“Manual” Speed Sources

The manual source for speed command to the drive is either the HIM requesting manual control (see ALT Functions on page C-2) or the control terminal block (analog input) if a digital input is programmed to “Auto/Manual.”

Changing Speed Sources

The selection of the active Speed Reference can be made through digital inputs, DPI command, jog button, or Auto/Manual HIM operation.

Figure 1.12 Speed Reference Selection Chart (1)



Auto/Manual Examples

PLC = Auto, HIM = Manual

A process is run by a PLC when in Auto mode and requires manual control from the HIM during set-up. The Auto speed reference is issued by the PLC through a communications module installed in the drive. Since the internal communications is designated as Port 5, [Speed Ref A Sel] is set to "DPI Port 5" with the drive running from the Auto source.

Attain Manual Control

- Press ALT then Auto/Man on the HIM.
  When the HIM attains manual control, the drive speed command comes from the HIM speed control keys or analog potentiometer.

Release to Auto Control

- Press ALT then Auto/Man on the HIM again.
  When the HIM releases manual control, the drive speed command returns to the PLC.

PLC = Auto, Terminal Block = Manual

A process is run by a PLC when in Auto mode and requires manual control from an analog potentiometer wired to the drive terminal block. The auto

(1) To access Preset Speed 1, set Parameter 090 or 093 to "Preset Speed 1."

speed reference is issued by the PLC through a communications module installed in the drive. Since the internal communications is designated as Port 5, [Speed Ref A Sel] is set to "DPI Port 5" with the drive running from the Auto source. Since the Manual speed reference is issued by an analog input ("Analog In 1 or 2"), [TB Man Ref Sel] is set to the same input. To switch between Auto and Manual, [Digital In4 Sel] is set to "Auto/Manual."

Attain Manual Control

- Close the digital input.
  With the input closed, the speed command comes from the potentiometer.

Release to Auto Control

- Open the digital input.
  With the input open, the speed command returns to the PLC.

Auto/Manual Notes

1. Manual control is exclusive. If a HIM or Terminal Block takes manual control, no other device can take manual control until the controlling device releases manual control.
2. If a HIM has manual control and power is removed from the drive, the drive will return to Auto mode when power is reapplied.

CE Compliance

Low Voltage Compliance

The LPM15 drive is compliant with the essential requirements of the Low Voltage Directive 73/23/EEC when installed according to this user manual including the Notes and Requirements of this section. Compliance with the Low Voltage Directive has been demonstrated using the harmonized European standard EN 50178.

EMC Compliance

The LPM15 drive as supplied by Rockwell Automation does not satisfy the essential requirements of the EMC Directive 89/336/EEC. Compliance with the EMC Directive is the responsibility of the machine builder incorporating the LPM15 into an overall machine. The LPM15 produces conducted and radiated electromagnetic emissions which can interfere with other equipment, and the machine builder must provide appropriate mitigation to insure that the LPM15 does not disturb other equipment.

General Notes

- Without external mitigation, LPM15 drives are not intended to be used on a low-voltage public network which supplies residential or office premises; low frequency and radio frequency interference is expected if used in such an environment.
- The drive motor cable should be kept as short as possible in order to minimize capacitive currents which are a source of high frequency conducted emissions.
- Use of line filters in unearthed supply systems is not recommended.

Requirements for CE Compliance

1. Compliance with all warnings in this manual relating to electrical shock and thermal considerations in the installation.
2. In general, machines in the industrial environment must meet the high frequency emission requirements of EN 61000-6-4. Machines in the residential, commercial, and light industrial environment must meet the high frequency emission requirements of EN 61000-6-3.
3. Suitable high frequency line filter to mitigate conducted high frequency emissions.
4. Suitable line inductors for mitigation of harmonic current emissions if necessary for the application (public low voltage supply system).
5. Suitable enclosure which provides adequate mitigation of high frequency radiated emissions.
6. Grounding as described in Grounding the Drive on page 1-15.
7. Output power wiring to the motor and all control/signal wiring must use braided, shielded cable with a shield coverage of 75% or greater, or metal conduit.
8. The shields of all shielded cables must be terminated with the proper connectors to chassis/earth.

Notes:

Start Up

This chapter describes how you start up the LPM15. Refer to Appendix C for a brief description of the LCD HIM (Human Interface Module).

For information on...	See page...
Prepare For Drive Start-Up	2-1
Status Indicators	2-2
Start-Up Routines	2-3
Running S.M.A.R.T. Start	2-4
Running an Assisted Start Up	2-4

ATTENTION: Power must be applied to the drive to perform the following start-up procedure. Some of the voltages present are at incoming line potential. To avoid electric shock hazard or damage to equipment, only qualified service personnel should perform the following procedure. Thoroughly read and understand the procedure before beginning. If an event does not occur while performing this procedure, **Do Not Proceed**. **Remove Power** including user-supplied control voltages. User supplied voltages may exist even when main AC power is not applied to the drive. Correct the malfunction before continuing.

Prepare For Drive Start-Up

Before Applying Power to the Drive

❑ **1.** Confirm that all inputs are connected to the correct terminals and are secure.

❑ **2.** Verify that AC line power at the disconnect device is within the rated value of the drive.

❑ **3.** Verify that control power voltage is correct.

The remainder of this procedure requires that a HIM be installed. If an operator interface is not available, remote devices should be used to start up the drive.

Applying Power to the Drive

❑ **4.** Apply AC power and control voltages to the drive.

If any of the six digital inputs are configured to "Stop – CF" (CF = Clear Fault) or "Enable," verify that signals are present or reconfigure [Digital Inx Sel]. If an I/O option is not installed (i.e. no I/O terminal block), verify that [Digital Inx Sel] is not configured to "Stop – CF" or "Enable." If this is not done, the drive will not start. Refer to Alarm Descriptions on page 4-6 for a list of potential digital input conflicts. If a fault code appears, refer to Chapter 4.

If the STATUS LED is not flashing green at this point, refer to LED Status Definitions in Table 2.A.

❑ **5.** Proceed to Start-Up Routines.

Status Indicators

Figure 2.1 Drive Status Indicator

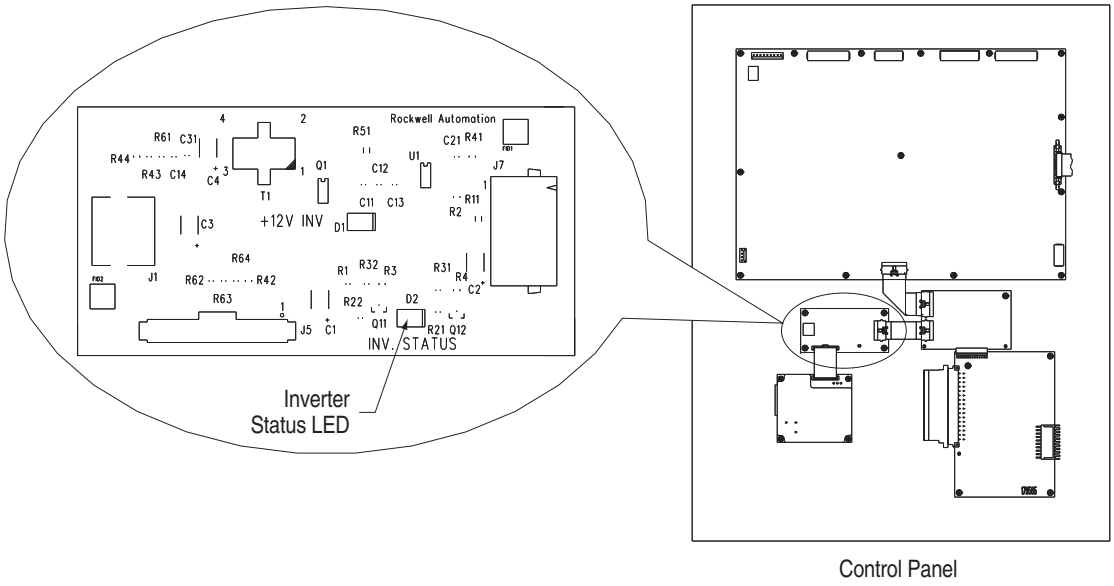


Table 2.A Ready LED Status Indications

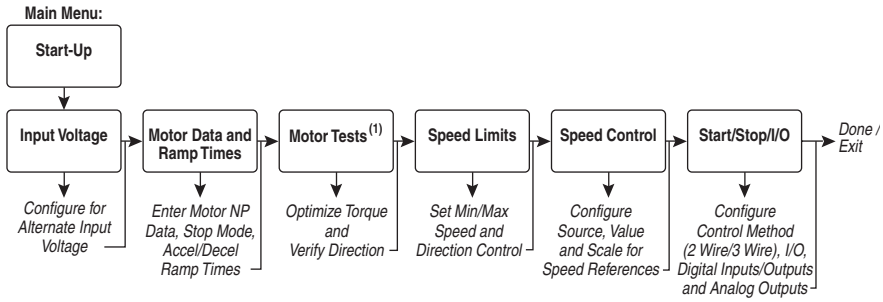
Color	State	Description
Green	Flashing	Drive ready, but not running and no faults are present.
	Steady	Drive running, no faults are present.
Yellow See page 4-2.	Flashing	The drive is not ready. Check parameter 214 [Start Inhibits].
	Steady	An alarm condition exists. Check parameters 211 [Drive Alarm 1] and 212 [Drive Alarm 2].
Red See page 4-3.	Flashing	A fault has occurred.
	Steady	A non-resettable fault has occurred.

Start-Up Routines

The LPM15 is designed so that start up is simple and efficient. If you have an LCD HIM, two start-up methods are provided, allowing the user to select the desired level needed for the application.

- **S.M.A.R.T. Start**
  This routine allows you to quickly set up the drive by programming values for the most commonly used functions. See page 2-4.
- **Assisted Start Up**
  This routine prompts you for information that is needed to start up a drive for most applications, such as line and motor data, commonly adjusted parameters and I/O. See page 2-4.

Figure 2.2 Standard Control Option Start Up Menu


Main Menu:
Start-Up
Input Voltage
Motor Data and Ramp Times
Motor Tests (1)
Speed Limits
Speed Control
Start/Stop/I/O
Done / Exit
Configure for Alternate Input Voltage
Enter Motor NP Data, Stop Mode, Accel/Decel Ramp Times
Optimize Torque and Verify Direction
Set Min/Max Speed and Direction Control
Configure Source, Value and Scale for Speed References
Configure Control Method (2 Wire/3 Wire), I/O, Digital Inputs/Outputs and Analog Outputs

(1) During Motor Tests and tuning procedures, the drive may modify certain parameter values for proper Start Up operation. These values are then reset to their original values when Start Up is complete. The affected parameters are: 053, 080, 276, 278, and 361-366. If power is removed from the drive during the tests without aborting the auto-tune procedure, these parameters may not be reset to their original value. If this situation occurs, reset the drive to factory defaults and repeat the Start Up procedure.

Important Information

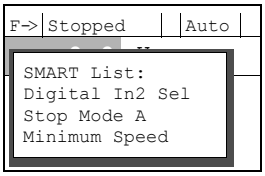
Power must be applied to the drive when viewing or changing parameters. Previous programming may affect the drive status and operation when power is applied.

Running S.M.A.R.T. Start

During a Start Up, the majority of applications require changes to only a few parameters. The LCD HIM on a LPM15 drive offers S.M.A.R.T. start, which displays the most commonly changed parameters. With these parameters, you can set the following functions:

S - Start Mode and Stop Mode
M - Minimum and Maximum Speed
A - Accel Time 1 and Decel Time 1
R - Reference Source
T - Thermal Motor Overload

To run a S.M.A.R.T. start routine:

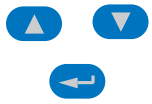
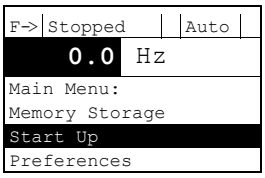
1. Press ALT and then Esc (S.M.A.R.T.). The S.M.A.R.T. start screen appears. 2. View and change parameter values as desired. For HIM information, see Appendix C. 3. Press Esc to exit the S.M.A.R.T. start.		

Running an Assisted Start Up

Important: This start-up routine requires an LCD HIM.

The Assisted start-up routine asks simple yes or no questions and prompts you to input required information. Access Assisted Start Up by selecting "Start Up" from the Main Menu.

To perform an Assisted Start-Up:

1. In the Main Menu, press the Up Arrow or Down Arrow to scroll to "Start Up". 2. Press Enter.		

Programming and Parameters

Chapter 3 provides a complete listing and description of the LPM15 parameters. The parameters can be programmed (viewed/edited) using an LCD HIM (Human Interface Module). As an alternative, programming can also be performed using DriveExplorer™ or DriveExecutive™ software and a personal computer. Refer to Appendix C for a brief description of the LCD HIM.

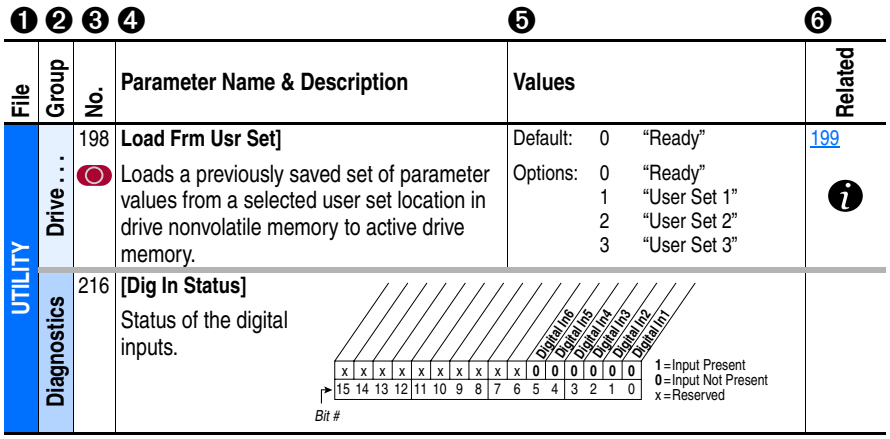
For information on...	See page...
About Parameters	3-1
How Parameters are Organized	3-2
Monitor File	3-6
Motor Control File	3-7
Speed Command File	3-10
Dynamic Control File	3-15
Utility File	3-19
Communication File	3-25
Inputs & Outputs File	3-28
Parameter Cross Reference – by Name	3-32
Parameter Cross Reference – by Number	3-33

About Parameters

To configure a drive to operate in a specific way, drive parameters may have to be set. Three types of parameters exist:

- **ENUM Parameters**
  ENUM parameters allow a selection from 2 or more items. The LCD HIM will display a text message for each item.
- **Bit Parameters**
  Bit parameters have individual bits associated with features or conditions. If the bit is 0, the feature is off or the condition is false. If the bit is 1, the feature is on or the condition is true.
- **Numeric Parameters**
  These parameters have a single numerical value (i.e. 0.1 Volts).

The example on the following page shows how each parameter type is presented in this manual.



No.	Description		
❶	**File** – Lists the major parameter file category.		
❷	**Group** – Lists the parameter group within a file.		
❸	**No.** – Parameter number. = Parameter value cannot be changed until drive is stopped. 32 = 32 bit parameter in the Standard Control option.		
❹	**Parameter Name & Description** – Parameter name as it appears on an LCD HIM, with a brief description of the parameters function.		
❺	**Values** – Defines the various operating characteristics of the parameter. Three types exist.		
	ENUM	Default:	Lists the value assigned at the factory. "Read Only" = no default.
		Options:	Displays the programming selections available.
	Bit	Bit:	Lists the bit place holder and definition for each bit.
	Numeric	Default:	Lists the value assigned at the factory. "Read Only" = no default.
		Min/Max:	The range (lowest and highest setting) possible for the parameter.
		Units:	Unit of measure and resolution as shown on the LCD HIM.
		Important: Some parameters will have two unit values. Analog inputs can be set for current or voltage with [Anlg In Config], parameter 320.	
		Important: When sending values through DPI ports, simply remove the decimal point to arrive at the correct value (i.e. to send "5.00 Hz," use "500").	
❻	**Related** – Lists parameters (if any) that interact with the selected parameter. The symbol "i" indicates that additional parameter information is available in Appendix D.		

How Parameters are Organized

The LCD HIM displays parameters in a **File-Group-Parameter** or **Numbered List** view order. To switch display mode, access the Main Menu, press ALT, then Sel while cursor is on the parameter selection. In addition to using [Param Access Lvl], the user has the option to display *all* parameters, commonly used parameters, or diagnostic parameters.

File-Group-Parameter Order

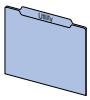
This simplifies programming by grouping parameters that are used for similar functions. The parameters are organized into 6 files in Basic Parameter view or 7 files in Advanced Parameter view. Each file is divided into groups, and each parameter is an element in a group. By default, the LCD HIM displays parameters by File-Group-Parameter view.

Numbered List View

All parameters are in numerical order.

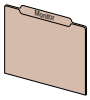
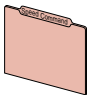
Basic Parameter View

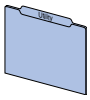
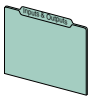
Parameter 196 [Param Access Lvl] set to option 0 “Basic.”

File	Group	Parameters					
Monitor	Metering	Output Freq Commanded Freq Output Current DC Bus Voltage	001 002 003 012				
Motor Control	Motor Data	Motor NP Volts Motor NP FLA Motor NP Hertz	041 042 043	Motor NP RPM Motor NP Power Mtr NP Pwr Units	044 045 046	Motor OL Hertz	047
	Torq Attributes	Torque Perf Mode Maximum Voltage	053 054	Maximum Freq Autotune	055 061		
Speed Command	Spd Mode & Limits	Minimum Speed Maximum Speed	081 082				
	Speed References	Speed Ref A Sel Speed Ref B Sel Speed Ref A Hi	090 093 091	Speed Ref B Hi Speed Ref A Lo Speed Ref B Lo	094 092 095	TB Man Ref Sel TB Man Ref Hi TB Man Ref Lo	096 097 098
	Discrete Speeds	Jog Speed Preset Speed 1-7	100 101-107				
Dynamic Control	Ramp Rates	Accel Time 1 Accel Time 2	140 141	Decel Time 1 Decel Time 2	142 143	S-Curve %	146
	Load Limits	Current Lmt Sel Current Lmt Val	147 148				
	Stop/Brake Modes	Stop Mode A Stop Mode B	155 156	DC Brk Lvl Sel DC Brake Level DC Brake Time	157 158 159	Bus Reg Mode A Bus Reg Mode B DB Resistor Type	161 162 163
	Restart Modes	Start At PowerUp	168	Auto Rstrt Tries	174	Auto Rstrt Delay	175
	Power Loss	Power Loss Mode	184	Power Loss Time	185		
Utility 	Direction Config	Direction Mode	190				
	Drive Memory	Param Access Lvl Reset To Defalts Load Frm Usr Set	196 197 198	Save To User Set Language	199 201		
	Faults	Fault Config 1	238				
Inputs & Outputs	Analog Inputs	Anlg In Config Analog In1 Hi Analog In2 Hi	320 322 325	Analog In1 Lo Analog In2 Lo	323 326		
	Analog Outputs	Analog Out1 Sel Analog Out1 Hi Analog Out1 Lo	342 343 344				
	Digital Inputs	Digital In1-6 Sel	361-366				
	Digital Outputs	Digital Out1 Sel Digital Out2 Sel	380 384	Dig Out1 Level Dig Out2 Level	381 385		

Advanced Parameter View

Parameter 196 [Param Access Lvl] set to option 1 “Advanced.”

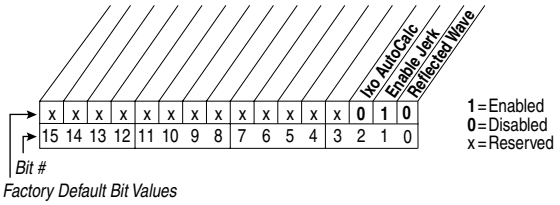
File	Group	Parameters					
Monitor 	Metering	Output Freq	001	Output Voltage	006	MOP Frequency	011
		Commanded Freq	002	Output Power	007	DC Bus Voltage	012
		Output Current	003	Output Powr Fctr	008	DC Bus Memory	013
		Torque Current	004	Elapsed MWh	009	Analog In1 Value	016
		Flux Current	005	Elapsed Run Time	010	Analog In2 Value	017
	Drive Data	Rated kW	026	Rated Amps	028		
		Rated Volts	027	Control SW Ver	029		
Motor Control	Motor Data	Motor Type	040	Motor NP RPM	044	Motor OL Factor	048
		Motor NP Volts	041	Motor NP Power	045		
		Motor NP FLA	042	Mtr NP Pwr Units	046		
		Motor NP Hertz	043	Motor OL Hertz	047		
	Torq Attributes	Torque Perf Mode	053	Flux Up Mode	057	IR Voltage Drop	062
		Maximum Voltage	054	Flux Up Time	058	Flux Current Ref	063
		Maximum Freq	055	SV Boost Filter	059	IXo Voltage Drop	064
		Compensation	056	Autotune	061		
	Volts per Hertz	Start/Acc Boost	069	Break Voltage	071		
		Run Boost	070	Break Frequency	072		
Speed Command 	Spd Mode & Limits	Speed Mode	080	Overspeed Limit	083	Skip Frequency 3	086
		Minimum Speed	081	Skip Frequency 1	084	Skip Freq Band	087
		Maximum Speed	082	Skip Frequency 2	085		
	Speed References	Speed Ref A Sel	090	Speed Ref B Sel	093	TB Man Ref Sel	096
		Speed Ref A Hi	091	Speed Ref B Hi	094	TB Man Ref Hi	097
		Speed Ref A Lo	092	Speed Ref B Lo	095	TB Man Ref Lo	098
	Discrete Speeds	Jog Speed	100				
		Preset Speed 1-7	101-107				
	Speed Trim	Trim In Select	117	Trim Hi	119		
		Trim Out Select	118	Trim Lo	120		
	Slip Comp	Slip RPM @ FLA	121	Slip RPM Meter	123		
		Slip Comp Gain	122				
	Process PI	PI Configuration	124	PI Integral Time	129	PI Status	134
		PI Control	125	PI Prop Gain	130	PI Ref Meter	135
		PI Reference Sel	126	PI Lower Limit	131	PI Fdback Meter	136
		PI Setpoint	127	PI Upper Limit	132	PI Error Meter	137
		PI Feedback Sel	128	PI Preload	133	PI Output Meter	138
Dynamic Control	Ramp Rates	Accel Time 1	140	Decel Time 1	142	S Curve %	146
		Accel Time 2	141	Decel Time 2	143		
	Load Limits	Current Lmt Sel	147	Drive OL Mode	150		
		Current Lmt Val	148	PWM Frequency	151		
		Current Lmt Gain	149				
	Stop/Brake Modes	Stop Mode A	155	DC Brake Time	159	DB Resistor Type	163
		Stop Mode B	156	Bus Reg Ki	160	Bus Reg Kp	164
		DC Brake Lvl Sel	157	Bus Reg Mode A	161	Bus Reg Kd	165
		DC Brake Level	158	Bus Reg Mode B	162		
	Restart Modes	Start At PowerUp	168	Auto Rstrt Delay	175	Wake Time	181
		Flying Start En	169	Sleep Wake-Mode	178	Sleep Level	182
		Flying StartGain	170	Sleep-Wake Ref	179	Sleep Time	183
		Auto Rstrt Tries	174	Wake Level	180		
	Power Loss	Power Loss Mode	184				
		Power Loss Time	185				
		Power Loss Level	186				

File	Group	Parameters					
Utility	Direction Config	Direction Mode	190				
	HIM Ref Config	Save HIM Ref	192				
		Man Ref Preload	193				
	MOP Config	Save MOP Ref	194				
		MOP Rate	195				
	Drive Memory	Param Access Lvl	196	Save To User Set	199	Voltage Class	202
		Reset To Defalts	197	Reset Meters	200	Drive Checksum	203
		Load Frm Usr Set	198	Language	201		
	Diagnostics	Drive Status 1	209	Dig Out Status	217	Status 2 @ Fault	228
		Drive Status 2	210	Drive Temp	218	Alarm 1 @ Fault	229
		Drive Alarm 1	211	Drive OL Count	219	Alarm 2 @ Fault	230
		Drive Alarm 2	212	Motor OL Count	220	Testpoint 1 Sel	234
		Speed Ref Source	213	Fault Speed	224	Testpoint 1 Data	235
		Start Inhibits	214	Fault Amps	225	Testpoint 2 Sel	236
		Last Stop Source	215	Fault Bus Volts	226	Testpoint 2 Data	237
		Dig In Status	216	Status 1 @ Fault	227		
	Faults	Fault Config 1	238	Fault Clear Mode	241	Fault 1-8 Code	243-257
		Fault Clear	240	Power Up Marker	242	Fault 1-8 Time	244-258
	Alarms	Alarm Config 1	259	Alarm1-8 Code	262-269		
		Alarm Clear	261				
Communication	Comm Control	DPI Baud Rate	270	Drive Ref Rslt	272		
		Drive Logic Rslt	271	Drive Ramp Rslt	273		
	Masks & Owners	Logic Mask	276	Fault Clr Mask	283	Reference Owner	292
		Start Mask	277	MOP Mask	284	Accel Owner	293
		Jog Mask	278	Local Mask	285	Decel Owner	294
		Direction Mask	279	Stop Owner	288	Fault Clr Owner	295
		Reference Mask	280	Start Owner	289	MOP Owner	296
		Accel Mask	281	Jog Owner	290	Local Owner	297
		Decel Mask	282	Direction Owner	291		
	Datalinks	Data In A1-D2	300-307				
		Data Out A1-D2	310-317				
Inputs & Outputs	Analog Inputs	Anlg In Config	320	Analog In 2 Hi	325	Anlg In 1 Loss	324
		Anlg In Sqr Root	321	Analog In 1 Lo	323	Anlg In 2 Loss	327
		Analog In 1 Hi	322	Analog In 2 Lo	326		
	Analog Outputs	Anlg Out Config	340	Analog Out1 Hi	343		
		Anlg Out Absolut	341	Analog Out1 Lo	344		
		Analog Out1 Sel	342				
	Digital Inputs	Digital In1-6 Sel	361-366				
	Digital Outputs	Digital Out1 Sel	380	Dig Out2 Level	385	Dig Out1 OffTime	383
		Digital Out2 Sel	384	Dig Out1 OnTime	382	Dig Out2 OffTime	387
		Dig Out1 Level	381	Dig Out2 OnTime	386		

Monitor File

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
MONITOR	Metering	001	**[Output Freq]** Output frequency present at T1, T2 & T3 (U, V & W).	Default: Read Only Min/Max: –/+[Maximum Freq] Units: 0.1 Hz	
		002	**[Commanded Freq]** Value of the active frequency command.	Default: Read Only Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	
		003	**[Output Current]** The total output current present at T1, T2 & T3 (U, V & W).	Default: Read Only Min/Max: 0.0/Drive Rated Amps × 2 Units: 0.1 Amps	
		004	**[Torque Current]** Based on the motor, the amount of current that is in phase with the fundamental voltage component.	Default: Read Only Min/Max: Drive Rating × –2/+2 Units: 0.1 Amps	
		005	**[Flux Current]** Amount of current that is out of phase with the fundamental voltage component.	Default: Read Only Min/Max: Drive Rating × –2/+2 Units: 0.1 Amps	
		006	**[Output Voltage]** Output voltage present at terminals T1, T2 & T3 (U, V & W).	Default: Read Only Min/Max: 0.0/Drive Rated Volts Units: 0.1 VAC	
		007	**[Output Power]** Output power present at T1, T2 & T3 (U, V & W).	Default: Read Only Min/Max: 0.0/Drive Rated kW × 2 Units: 0.1 kW	
		008	**[Output Powr Fctr]** Output power factor.	Default: Read Only Min/Max: 0.00/1.00 Units: 0.01	
		009	**[Elapsed MWh]** 32 Accumulated output energy of the drive.	Default: Read Only Min/Max: 0.0/214748364.0 MWh Units: 0.1 MWh	
		010	**[Elapsed Run Time]** 32 Accumulated time drive is outputting power.	Default: Read Only Min/Max: 0.0/429496729.5 Hrs Units: 0.1 Hrs	
		011	**[MOP Frequency]** Value of the signal at MOP (Motor Operated Potentiometer).	Default: Read Only Min/Max: –/+[Maximum Freq] Units: 0.1 Hz	
		012	**[DC Bus Voltage]** Present DC bus voltage level.	Default: Read Only Min/Max: 0.0/Based on Drive Rating Units: 0.1 VDC	
		013	**[DC Bus Memory]** 6 minute average of DC bus voltage level.	Default: Read Only Min/Max: 0.0/Based on Drive Rating Units: 0.1 VDC	
		016 017	**[Analog In1 Value]** **[Analog In2 Value]** Value of the signal at the analog inputs.	Default: Read Only Min/Max: 0.000/20.000 mA –/+10.000V Units: 0.001 mA 0.001 Volt	
	Drive Data	026	**[Rated kW]** 32 Drive power rating.	Default: Read Only Min/Max: 0.00/3000.00 kW Units: 0.01 kW	
		027	**[Rated Volts]** The drive input voltage class (208, 240, 400, etc.).	Default: Read Only Min/Max: 0.0/6553.5 VAC Units: 0.1 VAC	
		028	**[Rated Amps]** The drive rated output current.	Default: Read Only Min/Max: 0.0/6553.5 Amps Units: 0.1 Amps	
		029	**[Control SW Ver]** Main Control Board software version.	Default: Read Only Min/Max: 0.000/256.256 Units: 0.001	196

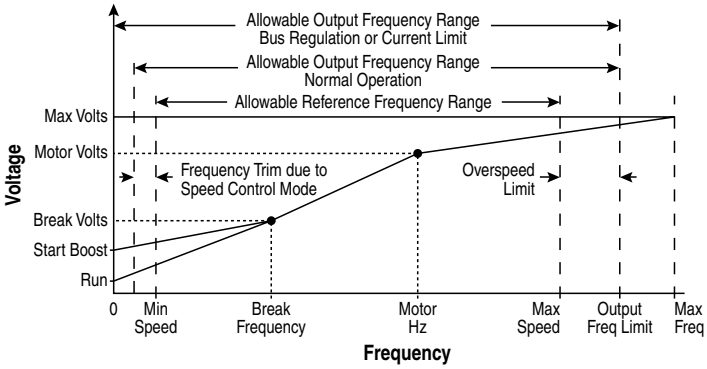
Motor Control File

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL	Motor Data	040	**[Motor Type]** Set to match the type of motor connected. (1) **Important:** Selecting option 1 or 2 also requires selection of "Custom V/Hz," option 2 in parameter 53.	Default: 0 "Induction" Options: 0 "Induction" 1 "Synchr Reluc" (1) 2 "Synchr PM" (1)	053
		041	**[Motor NP Volts]** Set to the motor nameplate rated volts.	Default: Based on Drive Rating Min/Max: 0.0/[Rated Volts] Units: 0.1 VAC	
		042	**[Motor NP FLA]** Set to the motor nameplate rated full load amps.	Default: Based on Drive Rating Min/Max: 0.0/[Rated Amps] × 2 Units: 0.1 Amps	047, 048
		043	**[Motor NP Hertz]** Set to the motor nameplate rated frequency.	Default: Based on Drive Cat. No. Min/Max: 5.0/400.0 Hz Units: 0.1 Hz	
		044	**[Motor NP RPM]** Set to the motor nameplate rated RPM.	Default: 1750 RPM Min/Max: 60/2400 RPM Units: 1 RPM	
		045	**[Motor NP Power]** Set to the motor nameplate rated power.	Default: Based on Drive Rating Min/Max: 0.00/100.00 Units: 0.01 kW/HP See [Mtr NP Pwr Units]	046
		046	**[Mtr NP Pwr Units]** Selects the motor power units to be used.	Default: Drive Rating Based Options: 0 "Horsepower" 1 "kiloWatts"	
		047	**[Motor OL Hertz]** Selects the output frequency below which the motor operating current is derated. The motor thermal overload will generate a fault at lower levels of current.	Default: Motor NP Hz/3 Min/Max: 0.0/Motor NP Hz Units: 0.1 Hz	042, 220
		048	**[Motor OL Factor]** Sets the operating level for the motor overload. Motor FLA x OL Factor = Operating Level	Default: 1.00 Min/Max: 0.20/2.00 Units: 0.01	042, 220
	Torq Attributes	053	**[Torque Perf Mode]** Sets the method of motor torque production.	Default: 0 "Sensrls Vect" Options: 0 "Sensrls Vect" 1 "SV Economize" 2 "Custom V/Hz" 3 "Fan/Pmp V/Hz"	
		054	**[Maximum Voltage]** Sets the highest voltage the drive will output.	Default: Drive Rated Volts Min/Max: Rated Volts x 0.25/Rated Volts Units: 0.1 VAC	
		055	**[Maximum Freq]** Sets the highest frequency the drive will output. Refer to parameter 083 [Overspeed Limit].	Default: 110.0 or 130.0 Hz Min/Max: 5.0/420.0 Hz Units: 0.1 Hz	083
		056	**[Compensation]** Enables/disables correction options.  *Factory Default Bit Values*		

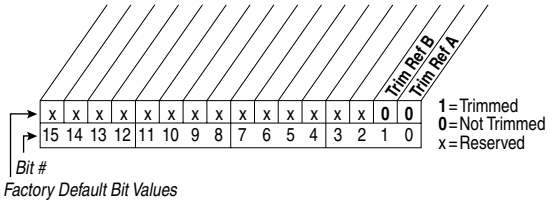
File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL	Torq Attributes	057	**[Flux Up Mode]** Automatic = Flux is established for a calculated time period based on motor nameplate data. [Flux Up Time] is not used. Manual = Flux is established for [Flux Up Time] before acceleration.	Default: 0 "Manual" Options: 0 "Manual" 1 "Automatic"	053, 058
		058	**[Flux Up Time]** Sets the amount of time the drive will use to try and achieve full motor stator flux. When a Start command is issued, DC current at current limit level is used to build stator flux before accelerating.	Default: 0.00 Secs Min/Max: 0.00/5.00 Secs Units: 0.01 Secs	053, 058
		059	**[SV Boost Filter]** Sets the amount of filtering used to boost voltage during Sensorless Vector operation.	Default: 500 Min/Max: 0/32767 Units: 1	
		061	**[Autotune]** Provides a manual or automatic method for setting [IR Voltage Drop], [Flux Current Ref], and [Ixo Voltage Drop]. Valid only when parameter 53 is set to "Sensrls Vect" or "SV Economize." "Ready" (0) = Parameter returns to this setting following a "Static Tune" or "Rotate Tune." It also permits manually setting [IR Voltage Drop], [Ixo Voltage Drop], and [Flux Current Ref]. "Static Tune" (1) = A temporary command that initiates a non-rotational motor stator resistance test for the best possible automatic setting of [IR Voltage Drop]. A start command is required following initiation of this setting. The parameter returns to "Ready" (0) following the test, at which time another start transition is required to operate the drive in normal mode. Used when motor cannot be rotated. "Rotate Tune" (2) = A temporary command that initiates a "Static Tune" followed by a rotational test for the best possible automatic setting of [Flux Current Ref]. A start command is required following initiation of this setting. The parameter returns to "Ready" (0) following the test, at which time another start transition is required to operate the drive in normal mode. **Important:** Used when motor is uncoupled from the load. Results may not be valid if a load is coupled to the motor during this procedure. **ATTENTION:** Rotation of the motor in an undesired direction can occur during this procedure. To guard against possible injury and/or equipment damage, it is recommended that the motor be disconnected from the load before proceeding. "Calculate" (3) = This setting uses motor nameplate data to automatically set [IR Voltage Drop], [Ixo Voltage Drop], [Flux Current Ref], and [Slip RPM @ FLA].	Default: 3 "Calculate" Options: 0 "Ready" 1 "Static Tune" 2 "Rotate Tune" 3 "Calculate"	053, 062
		062	**[IR Voltage Drop]** Value of voltage drop across the resistance of the motor stator at rated motor current. Used only when parameter 53 is set to "Sensrls Vect" or "SV Economize."	Default: Based on Drive Rating Min/Max: 0.0/[Motor NP Volts]×0.25 Units: 0.1 VAC	053, 061
		063	**[Flux Current Ref]** Value of amps for full motor flux. Used only when parameter 53 is set to "Sensrls Vect" or "SV Economize."	Default: Based on Drive Rating Min/Max: 0.00/[Motor NP FLA] Units: 0.01 Amps	053, 061
		064	**[Ixo Voltage Drop]** Value of voltage drop across the leakage inductance of the motor at rated motor current. Used only when parameter 53 is set to "Sensrls Vect" or "SV Economize."	Default: Based on Drive Rating Min/Max: 0.0/230.0, 480.0, 575 VAC Units: 0.1 VAC	

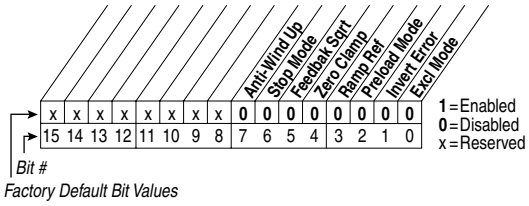
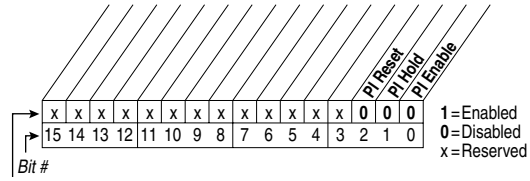
File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values		Related
MOTOR CONTROL	Volts per Hertz	069	**[Start/Acc Boost]** Sets the voltage boost level for starting and acceleration when "Custom V/Hz" mode is selected. Refer to parameter 083 [Overspeed Limit].	Default: Min/Max: Units:	Based on Drive Rating 0.0/[Motor NP Volts] × 0.25 0.1 VAC	053, 070
		070	**[Run Boost]** Sets the boost level for steady state or deceleration when "Fan/Pmp V/Hz" or "Custom V/Hz" modes are selected. See parameter 083 [Overspeed Limit].	Default: Min/Max: Units:	Based on Drive Rating 0.0/[Motor NP Volts] × 0.25 0.1 VAC	053, 069
		071	**[Break Voltage]** Sets the voltage the drive will output at [Break Frequency]. Refer to parameter 083 [Overspeed Limit].	Default: Min/Max: Units:	[Motor NP Volts] × 0.25 0.0/[Motor NP Volts] 0.1 VAC	053, 072
		072	**[Break Frequency]** Sets the frequency the drive will output at [Break Voltage]. Refer to parameter 083.	Default: Min/Max: Units:	[Motor NP Hz] × 0.25 0.0/[Maximum Freq] 0.1 Hz	053, 071

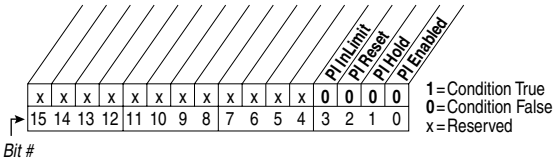
Speed Command File

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values		Related
SPEED COMMAND	Spd Mode & Limits	080	**[Speed Mode]** Sets the method of speed regulation.	Default: Options:	0 "Open Loop" 0 "Open Loop" 1 "Slip Comp" 2 "Process PI"	124 thru 138
		081	**[Minimum Speed]** Sets the low limit for speed reference after scaling is applied. Refer to parameter 083 [Overspeed Limit].	Default: Min/Max: Units:	0.0 0.0/[Maximum Speed] 0.1 Hz	083, 092, 095
		082	**[Maximum Speed]** Sets the high limit for speed reference after scaling is applied. Refer to parameter 083 [Overspeed Limit].	Default: Min/Max: Units:	50.0 or 60.0 Hz (volt class) [Motor NP RPM] 5.0/400.0 Hz 0.1 Hz	055, 083, 091, 094, 202
		083	**[Overspeed Limit]** Sets the incremental amount of the output frequency (above [Maximum Speed]) allowable for functions such as slip compensation. [Maximum Speed] + [Overspeed Limit] must be ≤ [Maximum Freq]  	Default: Min/Max: Units:	10.0 Hz 0.0/20.0 Hz 0.1 Hz	055, 082
		084 085 086	**[Skip Frequency 1]** **[Skip Frequency 2]** **[Skip Frequency 3]** Sets a frequency at which the drive will not operate. [Skip Frequency 1-3] and [Skip Frequency Band] must not equal 0.	Default: Default: Default: Min/Max: Units:	0.0 Hz 0.0 Hz 0.0 Hz –/+[Maximum Speed] 0.1 Hz	087
		087	**[Skip Freq Band]** Determines the bandwidth around a skip frequency. [Skip Freq Band] is split, applying 1/2 above and 1/2 below the actual skip frequency. The same bandwidth applies to all skip frequencies.	Default: Min/Max: Units:	0.0 Hz 0.0/30.0 Hz 0.1 Hz	084, 085, 086

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values			Related
SPEED COMMAND	Speed Reference	090	**[Speed Ref A Sel]** Selects the source of the speed reference to the drive unless [Speed Ref B Sel] or [Preset Speed 1-7] is selected. (1) See Figure 1.4 on page 1-8 for DPI Port 3 location.	Default: Options:	2 1 2 3-8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	"Analog In 2" "Analog In 1" "Analog In 2" "Reserved" "MOP Level" "Reserved" "Preset Spd1" "Preset Spd2" "Preset Spd3" "Preset Spd4" "Preset Spd5" "Preset Spd6" "Preset Spd7" "DPI Port 1" (1) "DPI Port 2" (1) "DPI Port 3" (1) "DPI Port 4" (1) "DPI Port 5" (1)	002 091 thru 093 101 thru 107 117 thru 120 192 thru 194 213 272 273 320 361 thru 366
		091	**[Speed Ref A Hi]** Scales the upper value of the [Speed Ref A Sel] selection when the source is an analog input.	Default: Min/Max: Units:	[Maximum Speed] –/+[Maximum Speed] 0.1 Hz		082
		092	**[Speed Ref A Lo]** Scales the lower value of the [Speed Ref A Sel] selection when the source is an analog input.	Default: Min/Max: Units:	0.0 –/+[Maximum Speed] 0.1 Hz		081
		093	**[Speed Ref B Sel]** See [Speed Ref A Sel].	Default: Options:	11 See [Speed Ref A Sel]	"Preset Spd1"	090
		094	**[Speed Ref B Hi]** Scales the upper value of the [Speed Ref B Sel] selection when the source is an analog input.	Default: Min/Max: Units:	[Maximum Speed] –/+[Maximum Speed] 0.1 Hz		093
		095	**[Speed Ref B Lo]** Scales the lower value of the [Speed Ref B Sel] selection when the source is an analog input.	Default: Min/Max: Units:	0.0 –/+[Maximum Speed] 0.1 Hz		090, 093
		096	**[TB Man Ref Sel]** Sets the manual speed reference source when a digital input is configured for "Auto/Manual." (1) "Analog In 2" is not a valid selection if it was selected for any of the following: - [Trim In Select] - [PI Feedback Sel] - [PI Reference Sel] - [Current Lmt Sel] - [Sleep-Wake Ref]	Default: Options:	1 1 2 3-8 9	"Analog In 1" "Analog In 1" "Analog In 2" (1) "Reserved" "MOP Level"	097, 098
		097	**[TB Man Ref Hi]** Scales the upper value of the [TB Man Ref Sel] selection when the source is an analog input.	Default: Min/Max: Units:	[Maximum Speed] –/+[Maximum Speed] 0.1 Hz		096
		098	**[TB Man Ref Lo]** Scales the lower value of the [TB Man Ref Sel] selection when the source is an analog input.	Default: Min/Max: Units:	0.0 –/+[Maximum Speed] 0.1 Hz		096

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND	Discrete Speeds	100	**[Jog Speed]** Sets the output frequency when a jog command is issued.	Default: 10.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	
		101 102 103 104 105 106 107	**[Preset Speed 1]** **[Preset Speed 2]** **[Preset Speed 3]** **[Preset Speed 4]** **[Preset Speed 5]** **[Preset Speed 6]** **[Preset Speed 7]** Provides an internal fixed speed command value. In bipolar mode direction is commanded by the sign of the reference.	Default: 5.0 Hz 10.0 Hz 20.0 Hz 30.0 Hz 40.0 Hz 50.0 Hz 60.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	090, 093
	Speed Trim	117	**[Trim In Select]** Specifies which analog input signal is being used as a trim input.	Default: 2 "Analog In 2" Options: See [Speed Ref A Sel]	090, 093
		118	**[Trim Out Select]** Specifies which speed references are to be trimmed. 		117, 119, 120
		119	**[Trim Hi]** Scales the upper value of the [Trim In Select] selection when the source is an analog input.	Default: 60.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	082, 117
		120	**[Trim Lo]** Scales the lower value of the [Trim In Select] selection when the source is an analog input.	Default: 0.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	117
	Slip Comp		**Important:** Parameters in the Slip Comp Group are used to enable and tune the Slip Compensation Regulator. In order to allow the Slip Compensation Regulator to control drive operation, parameter 080 [Speed Mode] must be set to 1 "Slip Comp".		
		121	**[Slip RPM @ FLA]** Sets the amount of compensation to drive output at motor FLA. If the value of parameter 061 [Autotune] = 3 "Calculate," changes made to this parameter will not be accepted.	Default: Based on [Motor NP RPM] Min/Max: 0.0/1200.0 RPM Units: 0.1 RPM	061, 080, 122, 123
		122	**[Slip Comp Gain]** Sets the response time of slip compensation.	Default: 40.0 Min/Max: 1.0/100.0 Units: 0.1	080, 121, 122
		123	**[Slip RPM Meter]** Displays the present amount of adjustment being applied as slip compensation.	Default: Read Only Min/Max: 0.0/300.0 RPM Units: 0.1 RPM	080, 121, 122

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND	Process PI		**Important:** Parameters in the Process PI Group are used to enable and tune the PI Loop. In order to allow the PI Loop to control drive operation, parameter 080 [Speed Mode] must be set to 2 "Process PI".		
		124	**[PI Configuration]** Sets configuration of the PI regulator.  *Factory Default Bit Values*		124 thru 138
		125	**[PI Control]** Controls the PI regulator.  *Factory Default Bit Values*		080
		126	**[PI Reference Sel]** Selects the source of the PI reference.	Default: 0 "PI Setpoint" Options: 0 "PI Setpoint" 1 "Analog In 1" 2 "Analog In 2" 3-8 "Reserved" 9 "MOP Level" 10 "Master Ref" 11-17 "Preset Spd1-7" 18-22 "DPI Port 1-5"	124 thru 138
		127	**[PI Setpoint]** Provides an internal fixed value for process setpoint when [PI Reference Sel] is set to "PI Setpoint."	Default: 50.00% Min/Max: –/+100.00% of Max. Process Value Units: 0.01%	124 thru 138
		128	**[PI Feedback Sel]** Selects the source of the PI feedback.	Default: 2 "Analog In 2" Options: See [PI Reference Sel].	124 thru 138
		129	**[PI Integral Time]** Time required for the integral component to reach 100% of [PI Error Meter]. Not functional when the PI Hold bit of [PI Control] = "1" (enabled).	Default: 2.0 Secs Min/Max: 0.00/100.00 Secs Units: 0.01 Secs	124 thru 138
		130	**[PI Prop Gain]** Sets the value for the PI proportional component. PI Error x PI Prop Gain = PI Output	Default: 1.0 Min/Max: 0.00/100.00 Units: 0.01	124 thru 138
		131	**[PI Lower Limit]** Sets the lower limit of the PI output.	Default: –[Maximum Freq] Min/Max: –/+400.0 Hz Units: 0.1 Hz	124 thru 138
		132	**[PI Upper Limit]** Sets the upper limit of the PI output.	Default: +[Maximum Freq] Min/Max: –/+400.0 Hz Units: 0.1 Hz	124 thru 138

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values		Related
SPEED COMMAND	Process PI	133	**[PI Preload]** Sets the value used to preload the integral component on start or enable.	Default: Min/Max: Units:	0.0 Hz –/+400.0 Hz 0.1 Hz	124 thru 138
		134	**[PI Status]** Status of the Process PI regulator. 		Read Only	124 thru 138
		135	**[PI Ref Meter]** Present value of the PI reference signal.	Default: Min/Max: Units:	Read Only –/+100.0% 0.1%	124 thru 138
		136	**[PI Fdback Meter]** Present value of the PI feedback signal.	Default: Min/Max: Units:	Read Only –/+100.0% 0.1%	124 thru 138
		137	**[PI Error Meter]** Present value of the PI error.	Default: Min/Max: Units:	Read Only –/+100.0% 0.1%	124 thru 138
		138	**[PI Output Meter]** Present value of the PI output.	Default: Min/Max: Units:	Read Only –/+100.0 Hz 0.1 Hz	124 thru 138

Dynamic Control File

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Ramp Rates	140 141	**[Accel Time 1]** **[Accel Time 2]** Sets the rate of accel for all speed increases. $\frac{\text{Max Speed}}{\text{Accel Time}}$ = Accel Rate	Default: 10.0 Secs 10.0 Secs Min/Max: 0.1/3600.0 Secs Units: 0.1 Secs	142, 143, 146, 361
		142 143	**[Decel Time 1]** **[Decel Time 2]** Sets the rate of decel for all speed decreases. $\frac{\text{Max Speed}}{\text{Decel Time}}$ = Decel Rate	Default: 10.0 Secs 10.0 Secs Min/Max: 0.1/3600.0 Secs Units: 0.1 Secs	140, 141, 146, 361
		146	**[S Curve %]** Sets the percentage of accel or decel time that is applied to the ramp as S Curve. Time is added, 1/2 at the beginning and 1/2 at the end of the ramp.	Default: 0% Min/Max: 0/100% Units: 1%	140 thru 143
	Load Limits	147	**[Current Lmt Sel]** Selects the source for the adjustment of current limit (i.e. parameter, analog input, etc.).	Default: 0 "Cur Lim Val" Options: 0 "Cur Lim Val" 1 "Analog In 1" 2 "Analog In 2"	146, 149
		148	**[Current Lmt Val]** Defines the current limit value when [Current Lmt Sel] = "Cur Lim Val."	Default: [Rated Amps] × 1.5 (Equation yields approximate default value.) Min/Max: Based on Drive Rating Units: 0.1 Amps	147, 149
		149	**[Current Lmt Gain]** Sets the responsiveness of the current limit.	Default: 250 Min/Max: 0/5000 Units: 1	147, 148
		150	**[Drive OL Mode]** Selects the drive's response to increasing drive temperature.	Default: 3 "Both–PWM 1st" Options: 0 "Disabled" 1 "Reduce CLim" 2 "Reduce PWM" 3 "Both–PWM 1st"	219
		151	**[PWM Frequency]** Sets the carrier frequency for the PWM output.	Default: 4 kHz Min/Max: 2/4 kHz Units: 1 kHz	
	Stop/Brake Modes	155 156	**[Stop Mode A]** **[Stop Mode B]** Active stop mode. [Stop Mode A] is active unless [Stop Mode B] is selected by inputs. (1) When using options 1 or 2, read this Attention statement.	Default: 1 "Ramp" Default: 0 "Coast" Options: 0 "Coast" 1 "Ramp" (1) 2 "Ramp to Hold" (1) 3 "DC Brake"	157, 158, 159
			ATTENTION: If a hazard of injury due to movement of equipment or material exists, an auxiliary mechanical braking device must be used.		
		157	**[DC Brake Lvl Sel]** Not available.		
		158	**[DC Brake Level]** Not available.		
		159	**[DC Brake Time]** Not available.		
		160	**[Bus Reg Ki]** Sets the responsiveness of the bus regulator.	Default: 450 Min/Max: 0/5000 Units: 1	161, 162

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Stop/Brake Modes	161 162	**[Bus Reg Mode A]** **[Bus Reg Mode B]** Sets the method and sequence of the DC bus regulator voltage. Choices are dynamic brake, frequency adjust, or both. Sequence is determined by programming or digital input to the terminal block. Dynamic Brake Setup If a dynamic brake resistor is connected to the drive, both of these parameters must be set to either option 2, 3 or 4. Refer to the Attention statement on page P-3 for important information on bus regulation. **ATTENTION:** The drive does not offer protection for externally mounted brake resistors. A risk of fire exists if external braking resistors are not protected. External resistor packages must be self-protected from over temperature or a protective circuit must be supplied.	Default: 1 "Adjust Freq" 4 "Both-Frq 1st" Options: 0 "Disabled" 1 "Adjust Freq" 2 "Dynamic Brak" 3 "Both-DB 1st" 4 "Both-Frq 1st"	160, 163
		163	**[DB Resistor Type]** Not available.		
		164	**[Bus Reg Kp]** Proportional gain for the bus regulator. Used to adjust regulator response.	Default: 1500 Min/Max: 0/10000 Units: 1	
		165	**[Bus Reg Kd]** Derivative gain for the bus regulator. Used to control regulator overshoot.	Default: 1000 Min/Max: 0/10000 Units: 1	
	Restart Modes	168	**[Start At PowerUp]** Enables/disables a feature to issue a Start or Run command and automatically resume running at commanded speed after drive input power is restored. Requires a digital input configured for Run or Start and a valid start contact. **ATTENTION:** Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national, and international codes, standards, regulations or industry guidelines.	Default: 0 "Disabled" Options: 0 "Disabled" 1 "Enabled"	
		169	**[Flying Start En]** Enables/disables the function which reconnects to a spinning motor at actual RPM when a start command is issued.	Default: 0 "Disabled" Options: 0 "Disabled" 1 "Enabled"	170
		170	**[Flying StartGain]** Sets the response of the flying start function.	Default: 4000 Min/Max: 20/32767 Units: 1	169
		174	**[Auto Rstrt Tries]** Sets the maximum number of times the drive attempts to reset a fault and restart. **ATTENTION:** Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national, and international codes, standards, regulations or industry guidelines.	Default: 0 Min/Max: 0/9 Units: 1	175
		175	**[Auto Rstrt Delay]** Sets the time between restart attempts when [Auto Rstrt Tries] is set to a value other than zero.	Default: 1.0 Secs Min/Max: 0.5/30.0 Secs Units: 0.1 Secs	174

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Restart Modes	178	**[Sleep-Wake Mode]** Enables/disables the Sleep/Wake function. **Important:** When enabled, the following conditions must be met: • A proper minimum value must be programmed for [Sleep Level]. • A speed reference must be selected in [Speed Ref A Sel]. • At least one of the following must be programmed (and input closed) in [Digital Inx Sel]; "Enable," "Stop=CF," "Run," "Run Forward," "Run Reverse."	Default: 0 "Disabled" Options: 0 "Disabled" 1 "Direct" (Enabled)	
		179	**[Sleep-Wake Ref]** Selects the source of the input controlling the Sleep-Wake function.	Default: 2 "Analog In 2" Options: 1 "Analog In 1" 2 "Analog In 2"	
		180	**[Wake Level]** Defines the analog input level that will start the drive.	Default: 6.000 mA, 6.000 Volts Min/Max: [Sleep Level]/20.000 mA [Sleep Level]/10.000 Volts Units: 0.001 mA 0.001 Volts	181
		181	**[Wake Time]** Defines the amount of time at or above [Wake Level] before a Start is issued.	Default: 1.0 Secs Min/Max: 0.0/30.0 Secs Units: 0.1 Secs	180
		182	**[Sleep Level]** Defines the analog input level that will stop the drive.	Default: 5.000 mA, 5.000 Volts Min/Max: 4.000 mA/[Wake Level] 0.000 Volts/[Wake Level] Units: 0.001 mA 0.001 Volts	183
		183	**[Sleep Time]** Defines the amount of time at or below [Sleep Level] before a Stop is issued.	Default: 1.0 Secs Min/Max: 0.0/30.0 Secs Units: 0.1 Secs	182

ATTENTION: Enabling the Sleep-Wake function can cause unexpected machine operation during the Wake mode. Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national, and international codes, standards, regulations or industry guidelines.

Conditions Required to Start Drive (1) (2) (3)

Input	After Power-Up	After a Drive Fault		After a Stop Command
		Reset by Stop-CF, HIM or TB	*Reset by Clear Faults (TB)*	*HIM or TB*
Stop	Stop Closed Wake Signal	Stop Closed Wake Signal New Start or Run Cmd. (4)	Stop Closed Wake Signal	Stop Closed Analog Sig. > Sleep Level (6) New Start or Run Cmd. (4)
Enable	Enable Closed Wake Signal (4)	Enable Closed Wake Signal New Start or Run Cmd. (4)	Enable Closed Wake Signal	Enable Closed Analog Sig. > Sleep Level (6) New Start or Run Cmd. (4)
Run Run Forward Run Reverse	Run Closed Wake Signal	New Run Cmd. (5) Wake Signal	Run Closed Wake Signal	New Run Cmd. (5) Wake Signal

(1) When power is cycled, if all conditions are present after power is restored, restart will occur.

(2) If all conditions are present when [Sleep-Wake Mode] is "enabled," the drive will start.

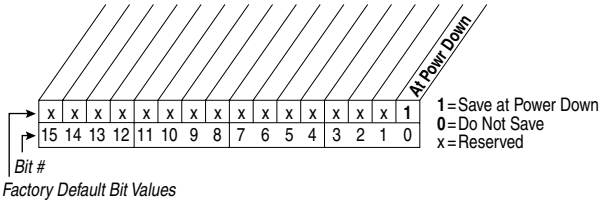
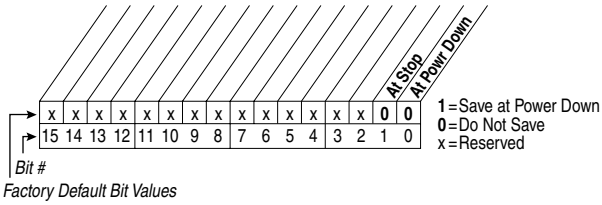
(3) The active speed reference is determined as explained in Reference Control on page 1-28. The Sleep/Wake function and the speed reference may be assigned to the same input.

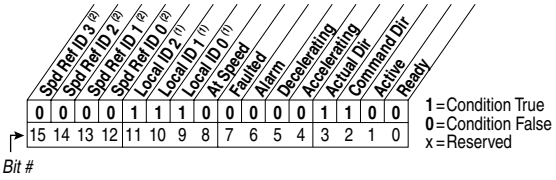
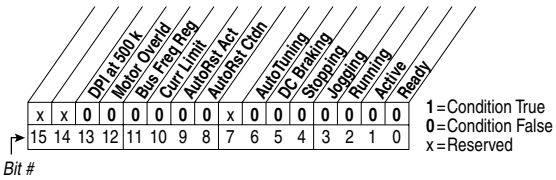
(4) Command must be issued from HIM, TB or network.

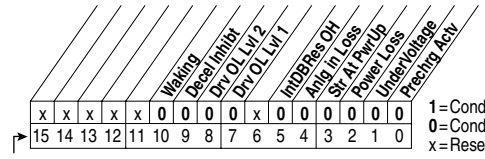
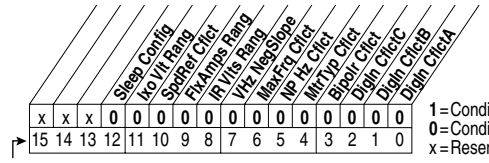
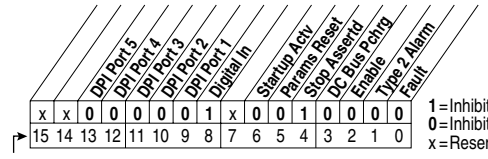
(5) Run Command must be cycled.

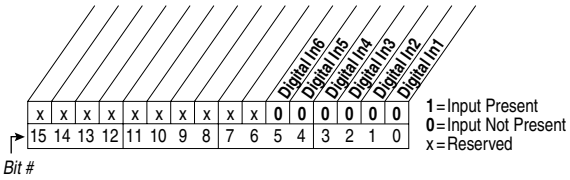
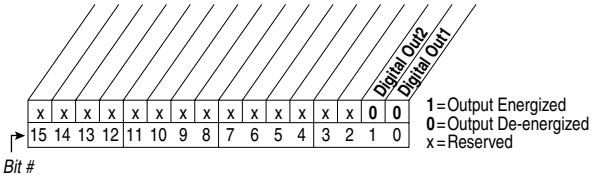
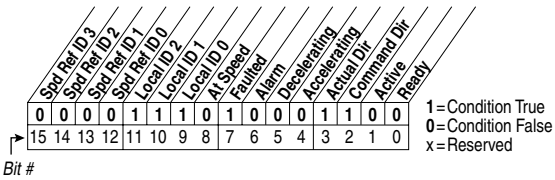
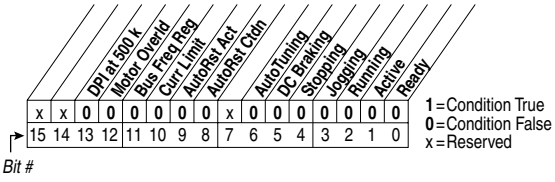
File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Power Loss	184	**[Power Loss Mode]** Sets the reaction to a loss of input power. Power loss is recognized when: • DC bus voltage is ≤ 73% of [DC Bus Memory] and [Power Loss Mode] is set to "Coast." • DC bus voltage is ≤ 82% of [DC Bus Memory] and [Power Loss Mode] is set to "Decel."	Default: 0 "Coast" Options: 0 "Coast" 1 "Decel" 2 "Continue" 3 "Coast Input" 4 "Decel Input"	013, 185
		185	**[Power Loss Time]** Sets the time that the drive will remain in power loss mode before a fault is issued.	Default: 0.5 Secs Min/Max: 0.0/60.0 Secs Units: 0.1 Secs	184
		186	**[Power Loss Level]** Sets the level at which the [Power Loss Mode] selection will occur. The drive can use the percentages referenced in [Power Loss Mode] or a trigger point can be set for line loss detection as follows: $V_{trigger}$ = [DC Bus Memory] – [Power Loss Level] A digital input (programmed to "29, Pwr Loss Lvl") is used to toggle between fixed percentages and the detection level. **ATTENTION:** Drive damage can occur if proper input impedance is not provided as explained below. If the value for [Power Loss Level] is greater than 18% of [DC Bus Memory], the user must provide a minimum line impedance to limit inrush current when the power line recovers. The input impedance should be equal to or greater than the equivalent of a 5% transformer with a VA rating 5 times the drives input VA rating.	Default: Drive Rated Volts Min/Max: 0.0/999.9 VDC Units: 0.1 VDC	

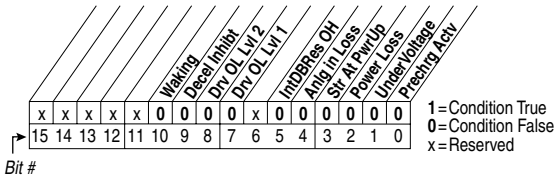
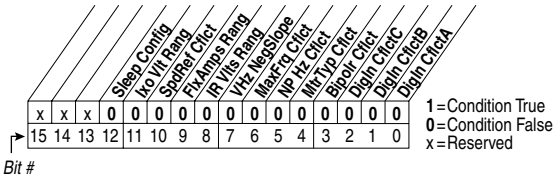
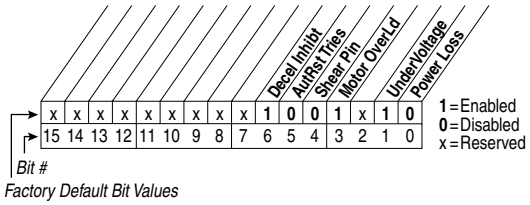
Utility File

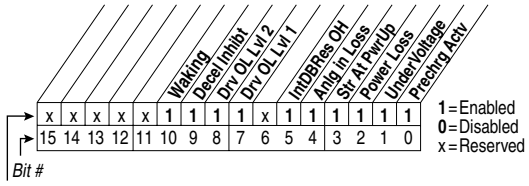
File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY	Direction Config	190	**[Direction Mode]** Selects the method for changing drive direction. Mode / Direction Change Unipolar / Drive Logic Bipolar / Sign of Reference Reverse Dis / Not Changeable	Default: 0 "Unipolar" Options: 0 "Unipolar" 1 "Bipolar" 2 "Reverse Dis"	320 thru 327 361 thru 366
	HIM Ref Config	192	**[Save HIM Ref]** Enables a feature to save the present frequency reference value issued by the HIM to Drive memory on power loss. Value is restored to the HIM on power up.  *Factory Default Bit Values*		
		193	**[Man Ref Preload]** Enables/disables a feature to automatically load the present "Auto" frequency reference value into the HIM when "Manual" is selected. Allows smooth speed transition from "Auto" to "Manual."	Default: 0 "Disabled" Options: 0 "Disabled" 1 "Enabled"	
	MOP Config	194	**[Save MOP Ref]** Enables/disables the feature that saves the present MOP frequency reference at power down or at stop.  *Factory Default Bit Values*		
		195	**[MOP Rate]** Sets rate of change of the MOP reference in response to a digital input.	Default: 1.0 Hz/s Min/Max: 0.2/[Maximum Freq] Units: 0.1 Hz/s	
	Drive Memory	196	**[Param Access Lvl]** Selects the parameter display level. Basic = Reduced parameter set Advanced = Full parameter set	Default: 0 "Basic" Options: 0 "Basic" 1 "Advanced" 2 "Reserved"	
		197	**[Reset To Defaults]** Resets parameters to factory defaults except [Language], [Param Access Lvl], and [Voltage Class] (params. 196, 201, and 202). • Option 1 resets parameters to factory defaults based on [Voltage Class]. • Options 2 and 3 will reset parameters to factory defaults and set [Voltage Class] to low or high voltage settings.	Default: 0 "Ready" Options: 0 "Ready" 1 "Factory" 2 "Low Voltage" 3 "High Voltage"	041 thru 047 054, 063, 069 thru 072 082, 148, 158
		198	**[Load Frm Usr Set]** Loads a previously saved set of parameter values from a selected user set location in drive nonvolatile memory to active drive memory.	Default: 0 "Ready" Options: 0 "Ready" 1 "User Set 1" 2 "User Set 2" 3 "User Set 3"	199
		199	**[Save To User Set]** Saves the parameter values in active drive memory to a user set in drive nonvolatile memory.	Default: 0 "Ready" Options: 0 "Ready" 1 "User Set 1" 2 "User Set 2" 3 "User Set 3"	198

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY	Drive Memory	200	**[Reset Meters]** Resets selected meters to zero.	Default: 0 "Ready" Options: 0 "Ready" 1 "MWh" 2 "Elapsed Time"	
		201	**[Language]** Selects the display language when using an LCD HIM. This parameter is not functional with an LED HIM. Options 6, 8, and 9 are "Reserved."	Default: 0 "Not Selected" Options: 0 "Not Selected" 1 "English" 2 "Francais" 3 "Español" 4 "Italiano" 5 "Deutsch" 7 "Português" 10 "Nederlands"	
		202	**[Voltage Class]** Configures the drive current rating and associates it with the selected voltage (i.e. 400 or 480V). Normally used when downloading parameter sets. Options 2 and 3 indicate status only.	Default: Based on Drive Cat. No. Options: 2 "Low Voltage" 3 "High Voltage"	041 thru 047 054, 055, 062, 063, 069 thru 072 082, 148, 158
		203	**[Drive Checksum]** Provides a checksum value that indicates whether or not a change in drive programming has occurred.	Default: Read Only Min/Max: 0/65535 Units: 1	
	Diagnostics	209	**[Drive Status 1]** Present operating condition of the drive.  Bits (2) / Description 15 14 13 12 Description 0 0 0 0 Ref A Auto 0 0 0 1 Ref B Auto 0 0 1 0 Preset 2 Auto 0 0 1 1 Preset 3 Auto 0 1 0 0 Preset 4 Auto 0 1 0 1 Preset 5 Auto 0 1 1 0 Preset 6 Auto 0 1 1 1 Preset 7 Auto 1 0 0 0 TB Manual 1 0 0 1 Port 1 Manual 1 0 1 0 Port 2 Manual 1 0 1 1 Port 3 Manual 1 1 0 0 Port 4 Manual 1 1 0 1 Port 5 Manual 1 1 1 0 Port 6 Manual 1 1 1 1 Jog Ref Bits (1) / Description 11 10 9 Description 0 0 0 Port 0 (TB) 0 0 1 Port 1 0 1 0 Port 2 0 1 1 Port 3 1 0 0 Port 4 1 0 1 Port 5 1 1 0 Port 6 1 1 1 No Local Control	Read Only	210
		210	**[Drive Status 2]** Present operating condition of the drive.  	Read Only	209

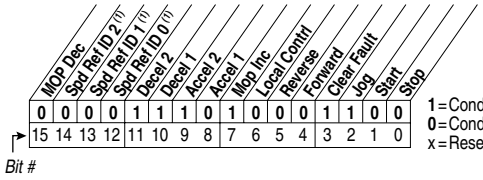
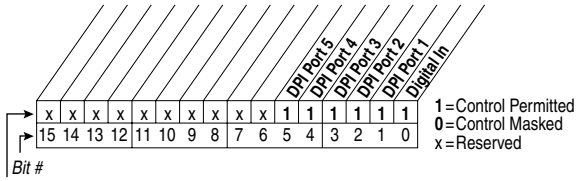
File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY	Diagnostics	211	**[Drive Alarm 1]** Alarm conditions that currently exist in the drive.  	Read Only	212
		212	**[Drive Alarm 2]** Alarm conditions that currently exist in the drive.  	Read Only	211
		213	**[Speed Ref Source]** Displays the source of the speed reference to the drive.	Default: Read Only Options: 0 "PI Output" 1 "Analog In 1" 2 "Analog In 2" 3-8 "Reserved" 9 "MOP Level" 10 "Jog Speed" 11 "Preset Spd1" 12 "Preset Spd2" 13 "Preset Spd3" 14 "Preset Spd4" 15 "Preset Spd5" 16 "Preset Spd6" 17 "Preset Spd7" 18 "DPI Port 1" 19 "DPI Port 2" 20 "DPI Port 3" 21 "DPI Port 4" 22 "DPI Port 5" 23 "Reserved"	090, 093, 096, 101
		214	**[Start Inhibits]** Displays the inputs currently preventing the drive from starting.  	Read Only	
		215	**[Last Stop Source]** Displays the source that initiated the most recent stop sequence. It will be cleared (set to 0) during the next start sequence.	Default: Read Only Options: 0 "Pwr Removed" 1-5 "DPI Port 1-5" 6 "Reserved" 7 "Digital In" 8 "Fault" 9 "Not Enabled" 10 "Sleep" 11 "Jog"	361, 362, 363, 364, 365, 366

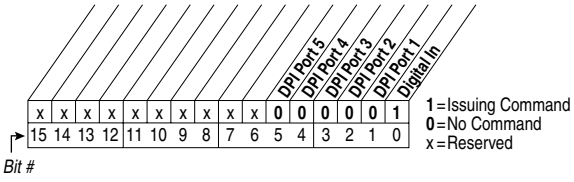
File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values		Related
UTILITY	Diagnostics	216	**[Dig In Status]** Status of the digital inputs.  		Read Only	361 thru 366
		217	**[Dig Out Status]** Status of the digital outputs.  		Read Only	380 thru 384
		218	**[Drive Temp]** Present operating temperature of the drive power section.	Default: Min/Max: Units:	Read Only 0.0/100.0% 0.1%	
		219	**[Drive OL Count]** Accumulated percentage of drive overload. Continuously operating the drive over 100% of its rating will increase this value to 100% and cause a drive fault or foldback depending on the setting of [Drive OL Mode].	Default: Min/Max: Units:	Read Only 0.0/100.0% 0.1%	150
		220	**[Motor OL Count]** Accumulated percentage of motor overload. Continuously operating the motor over 100% of the motor overload setting will increase this value to 100% and cause a drive fault.	Default: Min/Max: Units:	Read Only 0.0/100.0% 0.1%	047, 048
		224	**[Fault Frequency]** Captures and displays the output speed of the drive at the time of the last fault.	Default: Min/Max: Units:	Read Only 0.0/+[Maximum Freq] 0.1 Hz	225 thru 230
		225	**[Fault Amps]** Captures and displays motor amps at the time of the last fault.	Default: Min/Max: Units:	Read Only 0.0/[Rated Amps] × 2 0.1 Amps	224 thru 230
		226	**[Fault Bus Volts]** Captures and displays the DC bus voltage of the drive at the time of the last fault.	Default: Min/Max: Units:	Read Only 0.0/Max Bus Volts 0.1 VDC	224 thru 230
		227	**[Status 1 @ Fault]** Captures and displays [Drive Status 1] bit pattern at the time of the last fault.  		Read Only	209, 224 thru 230
		228	**[Status 2 @ Fault]** Captures and displays [Drive Status 2] bit pattern at the time of the last fault.  		Read Only	210, 224 thru 230

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY	Diagnostics	229	**[Alarm 1 @ Fault]** Captures and displays [Drive Alarm 1] at the time of the last fault. 	Read Only	211, 224 thru 230
		230	**[Alarm 2 @ Fault]** Captures and displays [Drive Alarm 2] at the time of the last fault. 	Read Only	212, 224 thru 230
		234 236	**[Testpoint 1 Sel]** **[Testpoint 2 Sel]** Selects the function whose value is displayed value in [Testpoint x Data]. These are internal values that are not accessible through parameters. See Testpoint Codes and Functions on page 4-10 for a listing of available codes and functions.	Default: 499 Min/Max: 0/65535 Units: 1	
		235 237 32	**[Testpoint 1 Data]** **[Testpoint 2 Data]** The present value of the function selected in [Testpoint x Sel].	Default: Read Only Min/Max: 0/4294967295 Units: 1	
	Faults	238	**[Fault Config 1]** Enables/disables annunciation of the listed faults. 		
		240	**[Fault Clear]** Resets a fault and clears the fault queue.	Default: 0 "Ready" Options: 0 "Ready" 1 "Clear Faults" 2 "Clr Flt Que"	
		241	**[Fault Clear Mode]** Enables/disables a fault reset (clear faults) attempt from any source. This does not apply to fault codes which are cleared indirectly via other actions.	Default: 1 "Enabled" Options: 0 "Disabled" 1 "Enabled"	
		242 32	**[Power Up Marker]** Elapsed hours since initial drive power up. This value will rollover to 0 after the drive has been powered on for more than the max value shown. For relevance to most recent power up, see [Fault x Time].	Default: Read Only Min/Max: 0.0000/429496.7295 Hr Units: 0.0001 Hr	244, 246, 248, 250, 252, 254, 256, 258

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY	Faults	243 245 247 249 251 253 255 257	**[Fault 1 Code]** **[Fault 2 Code]** **[Fault 3 Code]** **[Fault 4 Code]** **[Fault 5 Code]** **[Fault 6 Code]** **[Fault 7 Code]** **[Fault 8 Code]** A code that represents the fault that tripped the drive. The codes will appear in these parameters in the order they occur ([Fault 1 Code] = the most recent fault).	Default: Read Only Min/Max: 0/65535 Units: 0	
		244 246 248 250 252 254 256 258	**[Fault 1 Time]** **[Fault 2 Time]** **[Fault 3 Time]** **[Fault 4 Time]** **[Fault 5 Time]** **[Fault 6 Time]** **[Fault 7 Time]** **[Fault 8 Time]** 32 The time between **initial** drive power up and the occurrence of the associated trip fault. Can be compared to [Power Up Marker] for the time from the most recent power up. [Fault x Time] - [Power Up Marker] = Time Difference to Most Recent Power Up A negative value indicates fault occurred before most recent power up. A positive value indicates fault occurred after most recent power up.	Default: Read Only Min/Max: 0.0000/429496.7295 Hr 0.0000/214748.3647 Hr Units: 0.0001 Hr	242
	Alarms	259	**[Alarm Config 1]** Enables/disables alarm conditions that will initiate an active drive alarm.  *Factory Default Bit Values*		
		261	**[Alarm Clear]** Resets all [Alarm 1-8 Code] parameters to zero.	Default: 0 "Ready" Options: 0 "Ready" 1 "Clr Alrm Que"	262 thru 269
		262 263 264 265 266 267 268 269	**[Alarm 1 Code]** **[Alarm 2 Code]** **[Alarm 3 Code]** **[Alarm 4 Code]** **[Alarm 5 Code]** **[Alarm 6 Code]** **[Alarm 7 Code]** **[Alarm 8 Code]** A code that represents a drive alarm. The codes will appear in the order they occur (first 4 alarms in – first 4 out alarm queue). A time stamp is not available with alarms.	Default: Read Only Min/Max: 0/65535 Units: 1	261

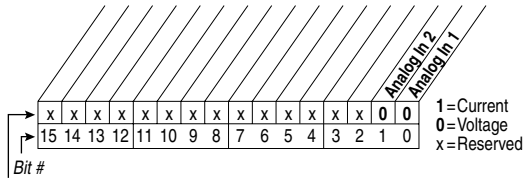
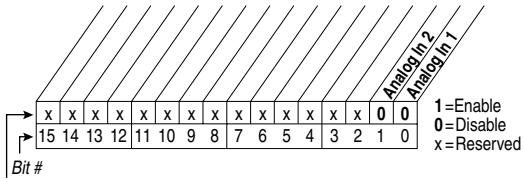
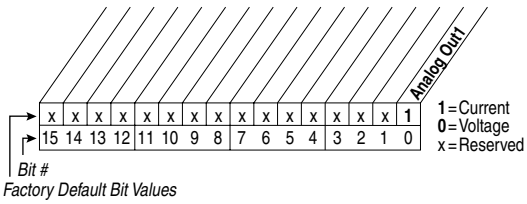
Communication File

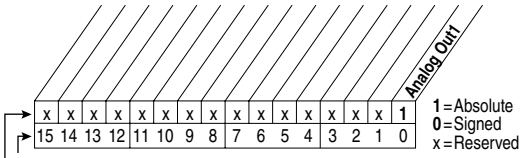
File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
COMMUNICATION	Comm Control	270	**[DPI Data Rate]** Sets the baud rate for attached drive peripherals. When changing this value the drive must be reset for the change to take affect.	Default: 1 "500 kbps" Options: 0 "125 kbps" 1 "500 kbps"	
		271	**[Drive Logic Rslt]** The final logic command resulting from the combination of all DPI and discrete inputs. This parameter has the same structure as the product-specific logic command received via DPI and is used in peer-to-peer communications.  (1) Bits 14, 13, 12: 0 0 0 No Command - Man. Mode 0 0 1 Ref A Auto 0 1 0 Ref B Auto 0 1 1 Preset 3 Auto 1 0 0 Preset 4 Auto 1 0 1 Preset 5 Auto 1 1 0 Preset 6 Auto 1 1 1 Preset 7 Auto	Read Only	
		272	**[Drive Ref Rslt]** Present frequency reference scaled as a DPI reference for peer-to-peer communications. The value shown is the value prior to the accel/decel ramp and the corrections supplied by slip comp, PI, etc.	Default: Read Only Min/Max: –/+32767 Units: 1	
		273	**[Drive Ramp Rslt]** Present frequency reference scaled as a DPI reference for peer-to-peer communications. The value shown is the value after the accel/decel ramp, but prior to any corrections supplied by slip comp, PI, etc.	Default: Read Only Min/Max: –/+32767 Units: 1	
	Masks & Owners	276	**[Logic Mask]** Determines which adapters can control the drive. If the bit for an adapter is set to "0," the adapter will have no control functions except for stop.  *Factory Default Bit Values*		288 thru 297
		277	**[Start Mask]** Controls which adapters can issue start commands.	See [Logic Mask].	288 thru 297
		278	**[Jog Mask]** Controls which adapters can issue jog commands.	See [Logic Mask].	288 thru 297
		279	**[Direction Mask]** Controls which adapters can issue forward/reverse direction commands.	See [Logic Mask].	288 thru 297
		280	**[Reference Mask]** Controls which adapters can select an alternate reference; [Speed Ref A, B Sel] or [Preset Speed 1-7].	See [Logic Mask].	288 thru 297
		281	**[Accel Mask]** Controls which adapters can select [Accel Time 1, 2].	See [Logic Mask].	288 thru 297
		282	**[Decel Mask]** Controls which adapters can select [Decel Time 1, 2].	See [Logic Mask].	288 thru 297

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
COMMUNICATION	Masks & Owners	283	**[Fault Clr Mask]** Controls which adapters can clear a fault.	See [Logic Mask].	288 thru 297
		284	**[MOP Mask]** Controls which adapters can issue MOP commands to the drive.	See [Logic Mask].	288 thru 297
		285	**[Local Mask]** Controls which adapters are allowed to take exclusive control of drive logic commands (except stop). Exclusive "local" control can only be taken while the drive is stopped.	See [Logic Mask].	288 thru 297
		288	**[Stop Owner]** Adapters that are presently issuing a valid stop command.  	Read Only	276 thru 285
		289	**[Start Owner]** Adapters that are presently issuing a valid start command.	See [Stop Owner].	276 thru 285
		290	**[Jog Owner]** Adapters that are presently issuing a valid jog command.	See [Stop Owner].	276 thru 285
		291	**[Direction Owner]** Adapter that currently has exclusive control of direction changes.	See [Stop Owner].	276 thru 285
		292	**[Reference Owner]** Adapter that has the exclusive control of the command frequency source selection.	See [Stop Owner].	276 thru 285
		293	**[Accel Owner]** Adapter that has exclusive control of selecting [Accel Time 1, 2].	See [Stop Owner].	140, 276 thru 285
		294	**[Decel Owner]** Adapter that has exclusive control of selecting [Decel Time 1, 2].	See [Stop Owner].	142, 276 thru 285
		295	**[Fault Clr Owner]** Adapter that is presently clearing a fault.	See [Stop Owner].	276 thru 285
		296	**[MOP Owner]** Adapters that are currently issuing increases or decreases in MOP command frequency.	See [Stop Owner].	276 thru 285
		297	**[Local Owner]** Adapter that has requested exclusive control of all drive logic functions. If an adapter is in local lockout, all other functions (except stop) on all other adapters are locked out and non-functional. Local control can only be obtained when the drive is not running.	See [Stop Owner].	276 thru 285

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
COMMUNICATION	Datalinks	300 301	**[Data In A1] - Link A Word 1** **[Data In A2] - Link A Word 2** Parameter number whose value will be written from a communications device data table. Parameters that can only be changed while drive is stopped cannot be used as Datalink inputs. Entering a parameter of this type will "Disable" the link.	Default: 0 (0 = "Disabled") Min/Max: 0/387 Units: 1	
		302 303	**[Data In B1] - Link B Word 1** **[Data In B2] - Link B Word 2**	See [Data In A1] - Link A Word 1 [Data In A2] - Link A Word 2.	
		304 305	**[Data In C1] - Link C Word 1** **[Data In C2] - Link C Word 2**	See [Data In A1] - Link A Word 1 [Data In A2] - Link A Word 2.	
		306 307	**[Data In D1] - Link D Word 1** **[Data In D2] - Link D Word 2**	See [Data In A1] - Link A Word 1 [Data In A2] - Link A Word 2.	
		310 311	**[Data Out A1] - Link A Word 1** **[Data Out A2] - Link A Word 2** Parameter number whose value will be written to a communications device data table.	Default: 0 (0 = "Disabled") Min/Max: 0/387 Units: 1	
		312 313	**[Data Out B1] - Link B Word 1** **[Data Out B2] - Link B Word 2**	See [Data Out A1] - Link A Word 1 [Data Out A2] - Link A Word 2.	
		314 315	**[Data Out C1] - Link C Word 1** **[Data Out C2] - Link C Word 2**	See [Data Out A1] - Link A Word 1 [Data Out A2] - Link A Word 2.	
		316 317	**[Data Out D1] - Link D Word 1** **[Data Out D2] - Link D Word 2**	See [Data Out A1] - Link A Word 1 [Data Out A2] - Link A Word 2.	

Inputs & Outputs File

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS	Analog Inputs	320	**[Anlg In Config]** Selects the mode for the analog inputs.  *Factory Default Bit Values*		322, 323
		321	**[Anlg In Sqr Root]** Enables/disables the square root function for each input.  *Factory Default Bit Values*		
		322 325	**[Analog In 1 Hi]** **[Analog In 2 Hi]** Sets the highest input value to the analog input x scaling block. [Anlg In Config], parameter 320 defines if this input will be –/+10V or 4-20 mA.	Default: 10.000 Volt 10.000 Volt Min/Max: 4.000/20.000mA –/+10.000V 0.000/10.000V Units: 0.001 mA 0.001 Volt	091, 092
		323 326	**[Analog In 1 Lo]** **[Analog In 2 Lo]** Sets the lowest input value to the analog input x scaling block. [Anlg In Config], parameter 320 defines if this input will be –/+10V or 4-20 mA.	Default: 0.000 Volt 0.000 Volt Min/Max: 4.000/20.000mA –/+10.000V 0.000/10.000V Units: 0.001 mA 0.001 Volt	091, 092
		324 327	**[Analog In 1 Loss]** **[Analog In 2 Loss]** Selects drive action when an analog signal loss is detected. Signal loss is defined as an analog signal less than 1V or 2mA. The signal loss event ends and normal operation resumes when the input signal level is greater than or equal to 1.5V or 3mA.	Default: 0 "Disabled" 0 "Disabled" Options: 0 "Disabled" 1 "Fault" 2 "Hold Input" 3 "Set Input Lo" 4 "Set Input Hi" 5 "Goto Preset1" 6 "Hold OutFreq"	091, 092
		340	**[Anlg Out Config]** Selects the mode for the analog outputs.  *Factory Default Bit Values*		

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS	Analog Outputs	341	**[Anlg Out Absolut]** Selects whether the signed value or absolute value of a parameter is used before being scaled to drive the analog output.  *Factory Default Bit Values*		
		342	**[Analog Out1 Sel]** Selects the source of the value that drives the analog output. **Options** / **[Analog Out1 Lo] Value** (*Param. 341 = Signed* / *Param. 341 = Absolute*) / **[Analog Out1 Hi] Value** 0 "Output Freq" — –[Maximum Speed] / 0 Hz — +[Maximum Speed] 1 "Command Freq" — –[Maximum Speed] / 0 Hz — +[Maximum Speed] 2 "Output Amps" — 0 Amps / 0 Amps — 200% Rated 3 "Torque Amps" — –200% Rated / 0 Amps — 200% Rated 4 "Flux Amps" — 0 Amps / 0 Amps — 200% Rated 5 "Output Power" — 0 kW / 0 kW — 200% Rated 6 "Output Volts" — 0 Volts / 0 Volts — 120% Rated Input Volts 7 "DC Bus Volts" — 0 Volts / 0 Volts — 200% Rated Input Volts 8 "PI Reference" — –100% / 0% — 100% 9 "PI Feedback" — –100% / 0% — 100% 10 "PI Error" — –100% / 0% — 100% 11 "PI Output" — –100% / 0% — 100% 12 "%Motor OL" — 0% / 0% — 100% 13 "%Drive OL" — 0% / 0% — 100%	Default: 0 "Output Freq" Options: See Table	001, 002, 003, 004, 005, 006, 007, 012, 135, 136, 137, 138, 220, 219
		343	**[Analog Out1 Hi]** Sets the analog output value when the source value is at maximum.	Default: 20.000 mA, 10.000 Volts Min/Max: 4.000/20.000mA –/+10.000V 0.000/10.000V Units: 0.001 mA 0.001 Volt	340, 342
		344	**[Analog Out1 Lo]** Sets the analog output value when the source value is at minimum.	Default: 0.000 mA, 0.000 Volts Min/Max: 4.000/20.000mA –/+10.000V 0.000/10.000V Units: 0.001 mA 0.001 Volt	340, 342

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS	Digital Inputs	361 362 363 364 365 366	**[Digital In1 Sel]** **[Digital In2 Sel]** **[Digital In3 Sel]** **[Digital In4 Sel]** **[Digital In5 Sel]** **[Digital In6 Sel]**	Default: 4 "Stop – CF" Default: 5 "Start" Default: 18 "Auto/ Manual" Default: 15 "Speed Sel 1" Default: 16 "Speed Sel 2" Default: 17 "Speed Sel 3"	
			Selects the function for the digital inputs. (1) Speed Select Inputs. 3 2 1 Auto Reference Source 0 0 0 Reference A 0 0 1 Reference B 0 1 0 Preset Speed 2 0 1 1 Preset Speed 3 1 0 0 Preset Speed 4 1 0 1 Preset Speed 5 1 1 0 Preset Speed 6 1 1 1 Preset Speed 7 To access Preset Speed 1, set [Speed Ref x Sel] to "Preset Speed 1." Type 2 Alarms - Some digital input programming may cause conflicts that will result in a Type 2 alarm. Example: [Digital In1 Sel] set to option 5 "Start" in 3-wire control and [Digital In2 Sel] set to option 7 "Run" in 2-wire. Refer to Table 4.C for information on resolving this type of conflict. (2) When [Digital Inx Sel] is set to option 2 "Clear Faults," the Stop button cannot be used to clear a fault condition. (3) Typical 3-Wire Inputs - Requires that only 3-wire functions are chosen. Including 2-wire selections will cause a Type 2 alarm.	Options: 0 "Not Used" 1 "Enable" (6) (8) 2 "Clear Faults" (CF) (2) 3 "Aux Fault" 4 "Stop – CF" (8) 5 "Start" (3) (7) 6 "Fwd/ Reverse" (3) 7 "Run" (4) (8) 8 "Run Forward" (4) 9 "Run Reverse" (4) 10 "Jog" (3) 11 "Jog Forward" (4) 12 "Jog Reverse" (4) 13 "Stop Mode B" 14 "Bus Reg Md B" 15-17 "Speed Sel 1-3" (1) 18 "Auto/ Manual" (5) 19 "Local" 20 "Acc2 & Dec2" 21 "Accel 2" 22 "Decel 2" 23 "MOP Inc" 24 "MOP Dec" 25 "Excl Link" 26 "PI Enable" 27 "PI Hold" 28 "PI Reset" 29 "Pwr Loss Lvl" 30 "Precharge En"	100 156 162 096 140 194 380 124
			(4) Typical 2-Wire Inputs - Requires that only 2-wire functions are chosen. Including 3-wire selections will cause a Type 2 alarm. See Table 4.C for conflicts. (5) Auto/Manual - Refer to page 1-29 for details. (6) Opening an "Enable" input will cause the motor to coast-to-stop, ignoring any programmed Stop modes. (7) A "Dig In ConflictB" alarm will occur if a "Start" input is programmed without a "Stop" input. (8) Refer to the Sleep-Wake Mode Attention statement on page 3-17.		

File	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values		Related
INPUTS & OUTPUTS	Digital Outputs	380 384	**[Digital Out1 Sel]** **[Digital Out2 Sel]** Selects the drive status that will energize a (CRx) output relay. (1) Any relay programmed as Fault or Alarm will energize (pick up) when power is applied to drive and deenergize (drop out) when a fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will deenergize when condition is removed. Refer to page 1-26. (2) Activation level is defined in [Dig Outx Level] below.	Default: Options:

Parameter Cross Reference – by Name

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Notes:

Troubleshooting

Chapter 4 provides information to guide you in troubleshooting the LPM15. Included is a listing and description of drive faults (with possible solutions, when applicable) and alarms.

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Faults and Alarms

A fault is a condition that stops the drive. There are three fault types.

Type	Fault Description	
①	Auto-Reset Run	When this type of fault occurs, and [Auto Rstrt Tries] (see page 3-16) is set to a value greater than "0," a user-configurable timer, [Auto Rstrt Delay] (see page 3-16) begins. When the timer reaches zero, the drive attempts to automatically reset the fault. If the condition that caused the fault is no longer present, the fault will be reset and the drive will be restarted.
②	Non-Resettable	This type of fault normally requires drive or motor repair. The cause of the fault must be corrected before the fault can be cleared. The fault will be reset on power up after repair.
③	User Configurable	These faults can be enabled/disabled to annunciate or ignore a fault condition.

An alarm is a condition that, if left untreated, may stop the drive. There are two alarm types.

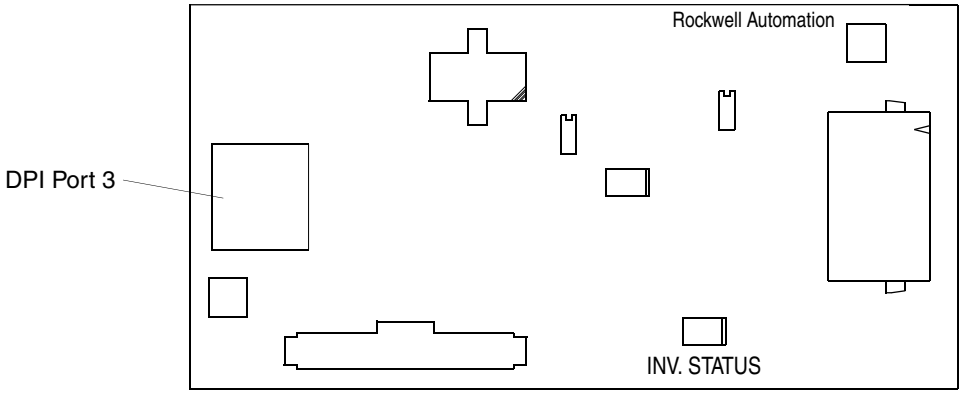
Type	Alarm Description	
①	User Configurable	These alarms can be enabled or disabled through [Alarm Config 1] on page 3-24.
②	Non-Configurable	These alarms are always enabled.

Drive Status

The condition or state of your drive is constantly monitored. Any changes will be indicated by the INV. STATUS LED on the DPI Communication Interface Board and/or the HIM (if present).

Front Panel LED Indications

Figure 4.1 Typical Inv. Status LED Indications



Color	State	Description
Green	Flashing	Drive ready, but not running & no faults are present.
	Steady	Drive running, no faults are present.
Yellow	Flashing	A Type 2 (non-configurable) alarm condition exists, drive continues to run.
	Steady	A Type 1 (user configurable) alarm condition exists, but drive continues to run.
Red	Flashing	A fault has occurred. Check [Fault x Code] or Fault Queue.
	Steady	A non-resettable fault has occurred.

HIM Indication

The LCD HIM also provides visual notification of a fault or alarm condition.

Condition	Display
Drive is indicating a fault. The LCD HIM immediately reports the fault condition by displaying the following: • "Faulted" appears in the status line • Fault number • Fault name • Time that has passed since fault occurred Press Esc to regain HIM control.	F-> Faulted Auto – Fault – F 5 OverVoltage Time Since Fault 0000:23:52
Drive is indicating an alarm. The LCD HIM immediately reports the alarm condition by displaying the following: • Alarm name (Type 2 alarms only) • Alarm bell graphic	F-> Power Loss Auto 0.0 Hz Main Menu: Diagnostics Parameter Device Select

Manually Clearing Faults

Step	Key(s)
1. Press Esc to acknowledge the fault. The fault information will be removed so that you can use the HIM.	Esc
2. Address the condition that caused the fault. The cause must be corrected before the fault can be cleared.	
3. After corrective action has been taken, clear the fault by **one** of these methods: • Press Stop • Cycle drive power • Set parameter 240 [Fault Clear] to "1." • "Clear Faults" on the HIM Diagnostic menu.	

Fault Descriptions

Table 4.A Fault Types, Descriptions and Actions

Fault	No.	Type (1)	Description	Action
Analog In Loss	29	① ③	An analog input is configured to fault on signal loss. A signal loss has occurred. Configure with [Anlg In 1, 2 Loss] on page 3-28.	1. Check parameters. 2. Check for broken/loose connections at inputs.
Anlg Cal Chksum	108		The checksum read from the analog calibration data does not match the checksum calculated.	Replace drive.
Auto Rstrt Tries	33	③	Drive unsuccessfully attempted to reset a fault and resume running for the programmed number of [Flt RstRun Tries]. Enable/Disable with [Fault Config 1] on page 3-23.	Correct the cause of the fault and manually clear.
AutoTune Aborted	80		Autotune function was canceled by the user or a fault occurred.	Restart procedure.
Auxiliary Input	2	①	Auxiliary input interlock is open.	Check remote wiring.
DB Resistance	69		Resistance of the internal DB resistor is out of range.	Replace resistor.
Decel Inhibit	24	③	The drive is not following a commanded deceleration because it is attempting to limit bus voltage.	1. Verify input voltage is within drive specified limits. 2. Verify system ground impedance follows proper grounding techniques. 3. Disable bus regulation and/or add dynamic brake resistor and/or extend deceleration time.
Drive OverLoad	64		Drive rating of 110% for 1 minute or 150% for 3 seconds has been exceeded.	Reduce load or extend Accel Time.
Drive Powerup	49		No fault displayed. Used as a Power Up Marker in the Fault Queue indicating that the drive power has been cycled.	
Excessive Load	79		Motor did not come up to speed in the allotted time during autotune.	1. Uncouple load from motor. 2. Repeat Autotune.
Faults Cleared	52		No fault displayed. Used as a marker in the Fault Queue indicating that the fault clear function was performed.	
Flt QueueCleared	51		No fault displayed. Used as a marker in the Fault Queue indicating that the clear queue function was performed.	
FluxAmpsRef Rang	78		The value for flux amps determined by the Autotune procedure exceeds the programmed [Motor NP FLA].	1. Reprogram [Motor NP FLA] with the correct motor nameplate value. 2. Repeat Autotune.
Gate Kill	68		Gate Kill contacts open.	Verify Gate Kill. Contacts are closed.
Ground Fault	13	①	A current path to earth ground greater than 25% of drive rating.	Check the motor and external wiring to the drive output terminals for a grounded condition.
Hardware Fault	93		Hardware enable is disabled (jumpered high) but logic pin is still low.	1. Check jumper. 2. Replace Main Control Board.

Table 4.A Fault Types, Descriptions and Actions (Continued)

Fault	No.	Type [1]	Description	Action
Hardware Fault	130		Gate array load error.	1. Cycle power. 2. Replace Main Control Board.
Hardware Fault	131		Dual port failure.	1. Cycle power. 2. Replace Main Control Board.
Heatsink OvrTemp	8	①	Heatsink temperature exceeds 100% of [Drive Temp].	1. Verify that maximum ambient temperature has not been exceeded. 2. Check fan. 3. Check for excess load.
HW OverCurrent	12	①	The drive output current has exceeded the hardware current limit.	Check programming. Check for excess load, improper DC boost setting, DC brake volts set too high or other causes of excess current.
Incompat MCB-PB	106	②	Drive rating information stored on the power board is incompatible with the main control board.	Load compatible version files into drive.
I/O Comm Loss	121		I/O Board lost communications with the Main Control Board.	Check connector. Check for induced noise. Replace I/O board or Main Control Board.
I/O Failure	122		I/O was detected, but failed the powerup sequence. I/O Board is separate in Standard Control.	Replace I/O Board (Standard Control).
IR Volts Range	77		"Calculate" is the autotune default and the value determined by the autotune procedure for IR Drop Volts is not in the range of acceptable values.	Re-enter motor nameplate data.
IXo VoltageRange	87		Voltage calculated for motor inductive impedance exceeds 25% of [Motor NP Volts].	1. Check for proper motor sizing. 2. Check for correct programming of [Motor NP Volts], parameter 41. 3. Additional output impedance may be required.
Motor Overload	7	① ③	Internal electronic overload trip. Enable/Disable with [Fault Config 1] on page 3-23.	An excessive motor load exists. Reduce load so drive output current does not exceed the current set by [Motor NP FLA].
NVS I/O Checksum	109		EEprom checksum error.	1. Cycle power and repeat function. 2. Replace Main Control Board.
NVS I/O Failure	110		EEprom I/O error.	1. Cycle power and repeat function. 2. Replace Main Control Board.
OverSpeed Limit	25	①	Functions such as Slip Compensation or Bus Regulation have attempted to add an output frequency adjustment greater than that programmed in [Overspeed Limit].	Remove excessive load or overhauling conditions or increase [Overspeed Limit].
OverVoltage	5	①	DC bus voltage exceeded maximum value.	Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install dynamic brake option.
Parameter Chksum	100	②	The checksum read from the board does not match the checksum calculated.	1. Restore defaults. 2. Reload User Set if used.
Params Defaulted	48		The drive was commanded to write default values to EEPROM.	1. Clear the fault or cycle power to the drive. 2. Program the drive parameters as needed.
Phase U to Grnd	38		A phase to ground fault has been detected between the drive and motor in this phase.	1. Check the wiring between the drive and motor. 2. Check motor for grounded phase. 3. Replace drive.
Phase V to Grnd	39			
Phase W to Grnd	40			
Phase UV Short	41		Excessive current has been detected between these two output terminals.	1. Check the motor and drive output terminal wiring for a shorted condition. 2. Replace drive.
Phase VW Short	42			
Phase UW Short	43			

Table 4.A Fault Types, Descriptions and Actions (Continued)

Fault	No.	Type [1]	Description	Action
Port 1-5 DPI Loss	81-85		DPI port stopped communicating. A SCANport device was connected to a drive operating DPI devices at 500k baud.	1. If adapter was not intentionally disconnected, check wiring to the port. Replace wiring, port expander, adapters, Main Control Board or complete drive as required. 2. Check HIM connection. 3. If an adapter was intentionally disconnected and the [Logic Mask] bit for that adapter is set to "1", this fault will occur. To disable this fault, set the [Logic Mask] bit for the adapter to "0."
Port 1-5 Adapter	71-75		The communications card has a fault.	Check DPI device event queue and corresponding fault information for the device.
Power Loss	3	① ③	DC bus voltage remained below 85% of nominal for longer than [Power Loss Time]. Enable/Disable with [Fault Config 1] on page 3-23.	Monitor the incoming AC line for low voltage or line power interruption.
Pwr Brd Chksum1	104		The checksum read from the EEPROM does not match the checksum calculated from the EEPROM data.	Clear the fault or cycle power to the drive.
Pwr Brd Chksum2	105	②	The checksum read from the board does not match the checksum calculated.	1. Cycle power to the drive. 2. If problem persists, replace drive.
Replaced MCB-PB	107	②	Main Control Board was replaced and parameters were not programmed.	1. Restore defaults. 2. Reprogram parameters.
Shear Pin	63	③	Programmed [Current Lmt Val] has been exceeded. Enable/Disable with [Fault Config 1] on page 3-23.	Check load requirements and [Current Lmt Val] setting.
Software Fault	88		Microprocessor handshake error.	Replace Main Control Board.
Software Fault	89		Microprocessor handshake error.	Replace Main Control Board.
SW OverCurrent	36	①	Drive output current has exceeded the 1ms current rating. This rating is greater than the 3 second current rating and less than the hardware overcurrent fault level. It is typically 200- 250% of the drive continuous rating	Check for excess load, improper DC boost setting. DC brake volts set too high.
Trnsistr OvrTemp	9	①	Output transistors have exceeded their maximum operating temperature.	1. Verify that maximum ambient temperature has not been exceeded. 2. Check fan. 3. Check for excess load.
UnderVoltage	4	① ③	DC bus voltage fell below the minimum value of 407V DC at 400/480V input or 204V DC at 200/240V input. Enable/Disable with [Fault Config 1] (page 3-23).	Monitor the incoming AC line for low voltage or power interruption.
UserSet1 Chksum	101	②	The checksum read from the user set does not match the checksum calculated.	Re-save user set.
UserSet2 Chksum	102	②		
UserSet3 Chksum	103	②		

[1] See page 4-1 for a description of fault types.

Table 4.B Fault Cross Reference – by Number

No. (1)	Fault	No. (1)	Fault	No. (1)	Fault
2	Auxiliary Input	41	Phase UV Short	81- 85	Port 1-5 DPI Loss
3	Power Loss	42	Phase VW Short	87	IXo VoltageRange
4	UnderVoltage	43	Phase UW Short	88	Software Fault
5	OverVoltage	48	Params Defaulted	89	Software Fault
7	Motor Overload	49	Drive Powerup	93	Hardware Fault
8	Heatsink OvrTemp	51	Flt QueueCleared	100	Parameter Chksum
9	Trnsistr OvrTemp	52	Faults Cleared	101-103	UserSet Chksum
12	HW OverCurrent	55	Cntl Bd Overtemp	104	Pwr Brd Chksum1
13	Ground Fault	63	Shear Pin	105	Pwr Brd Chksum2
24	Decel Inhibit	64	Drive OverLoad	106	Incompat MCB-PB
25	OverSpeed Limit	68	Gate Kill	107	Replaced MCB-PB
29	Analog In Loss	69	DB Resistance	108	Anlg Cal Chksum
33	Auto Rstrt Tries	71- 75	Port 1-5 Adapter	120	I/O Mismatch
36	SW OverCurrent	77	IR Volts Range	121	I/O Comm Loss
38	Phase U to Grnd	78	FluxAmpsRef Rang	122	I/O Failure
39	Phase V to Grnd	79	Excessive Load	130	Hardware Fault
40	Phase W to Grnd	80	AutoTune Aborted	131	Hardware Fault

(1) Fault numbers not listed are reserved for future use.

Clearing Alarms

Alarms are automatically cleared when the condition that caused the alarm is no longer present.

Alarm Descriptions

Table 4.C Alarm Descriptions and Actions

Alarm	No.	Type (1)	Description
Analog In Loss	5	①	An analog input is configured for "Alarm" on signal loss and signal loss has occurred.
Bipolar Conflict	20	②	Parameter 190 [Direction Mode] is set to "Bipolar" or "Reverse Dis" and one or more of the following digital input functions is configured: "Fwd/Reverse," "Run Forward," "Run Reverse," "Jog Forward" or "Jog Reverse."
Decel Inhibt	10	①	Drive is being inhibited from decelerating.
Dig In ConflictA	17	②	Digital input functions are in conflict. Combinations marked with a "🔔" will cause an alarm.

	Acc2/Dec2	Accel 2	Decel 2	Jog	Jog Fwd	Jog Rev	Fwd/ Rev
Acc2 / Dec2		🔔	🔔				
Accel 2	🔔						
Decel 2	🔔						
Jog*					🔔	🔔	
Jog Fwd				🔔			🔔
Jog Rev				🔔			🔔
Fwd/Rev					🔔	🔔	

Table 4.C Alarm Descriptions and Actions (Continued)

Alarm	No.	Type (1)	Description
Dig In ConflictB	18	②	A digital Start input has been configured without a Stop input or other functions are in conflict. Combinations that conflict are marked with a "🔔" and will cause an alarm.

	Start	Stop-CF	Run	Run Fwd	Run Rev	Jog	Jog Fwd	Jog Rev	Fwd/ Rev
Start			🔔	🔔	🔔		🔔	🔔	
Stop-CF									
Run	🔔			🔔	🔔		🔔	🔔	
Run Fwd	🔔		🔔			🔔			🔔
Run Rev	🔔		🔔			🔔			🔔
Jog*				🔔	🔔				
Jog Fwd	🔔		🔔						
Jog Rev	🔔		🔔						
Fwd/Rev				🔔	🔔				

Dig In ConflictC	19	②	More than one physical input has been configured to the same input function. Multiple configurations are not allowed for the following input functions: Forward/Reverse, Speed Select 1, Speed Select 2, Speed Select 3, Run Forward, Run Reverse, Jog Forward, Jog Reverse, Run, Stop Mode B, Bus Regulation Mode B, Acc2 / Dec2, Accel 2, Decel 2
Drive OL Level 1	8	①	The calculated IGBT temperature requires a reduction in PWM frequency. If [Drive OL Mode] is disabled and the load is not reduced, an overload fault will eventually occur.
Drive OL Level 2	9	①	The calculated IGBT temperature requires a reduction in Current Limit. If [Drive OL Mode] is disabled and the load is not reduced, an overload fault will eventually occur.
FluxAmpsRef Rang	26	②	The calculated or measured Flux Amps value is not within the expected range. Verify motor data and rerun motor tests.
IntDBRes OvrHeat	6	①	The drive has temporarily disabled the DB regulator because the resistor temperature has exceeded a predetermined value.
IR Volts Range	25	②	The drive auto tuning default is "Calculate" and the value calculated for IR Drop Volts is not in the range of acceptable values. This alarm should clear when all motor nameplate data is properly entered.
Ixo Vlt Rang	28	②	Motor leakage inductance is out of range.
MaxFreq Conflict	23	②	The sum of [Maximum Speed] and [Overspeed Limit] exceeds [Maximum Freq]. Raise [Maximum Freq] or lower [Maximum Speed] and/or [Overspeed Limit] so that the sum is less than or equal to [Maximum Freq].
Motor Type Cflct	21	②	[Motor Type] has been set to "Synchr Reluc" or "Synchr PM" and one or more of the following exist: • [Torque Perf Mode] = "Sensrls Vect," "SV Economize" or "Fan/Pmp V/Hz." • [Flux Up Time] is greater than 0.0 Secs. • [Speed Mode] is set to "Slip Comp." • [Autotune] = "Static Tune" or "Rotate Tune."
NP Hz Conflict	22	②	Fan/pump mode is selected in [Torq Perf Mode] and the ratio of [Motor NP Hertz] to [Maximum Freq] is greater than 26.
Power Loss	3	①	Drive has sensed a power line loss.
Precharge Active	1	①	Drive is in the initial DC bus precharge state.
Sleep Config	29	②	Sleep/Wake configuration error. With [Sleep-Wake Mode] = "Direct," possible causes include: drive is stopped and [Wake Level] < [Sleep Level]. "Stop = CF," "Run," "Run Forward," or "Run Reverse" is not configured in [Digital Inx Sel].
Speed Ref Cflct	27	②	[Speed Ref x Sel] or [PI Reference Sel] is set to "Reserved".
Start At PowerUp	4	①	[Start At PowerUp] is enabled. Drive may start at any time within 10 seconds of drive powerup.
UnderVoltage	2	①	The bus voltage has dropped below a predetermined value.

Table 4.C Alarm Descriptions and Actions (Continued)

Alarm	No.	Type [1]	Description
VHz Neg Slope	24	②	[Torq Perf Mode] = "Custom V/Hz" & the V/Hz slope is negative.
Waking	11	①	The Wake timer is counting toward a value that will start the drive.

[1] See page 4-1 for a description of alarm types.

Table 4.D Alarm Cross Reference – by Number

No. [1]	Alarm	No. [1]	Alarm	No. [1]	Alarm
1	Precharge Active	10	Decel Inhibt	23	MaxFreq Conflict
2	UnderVoltage	11	Waking	24	VHz Neg Slope
3	Power Loss	17	Dig In ConflictA	25	IR Volts Range
4	Start At PowerUp	18	Dig In ConflictB	26	FluxAmpsRef Rang
5	Analog in Loss	19	Dig In ConflictC	27	Speed Ref Cflct
6	IntDBRes OvrHeat	20	Bipolar Conflict	28	Ixo Vlt Rang
8	Drive OL Level 1	21	Motor Type Cflct	29	Sleep Config
9	Drive OL Level 2	22	NP Hz Conflict		

[1] Alarm numbers not listed are reserved for future use.

Common Symptoms and Corrective Actions

Drive does not Start from Start or Run Inputs wired to the terminal block.

Cause(s)	Indication	Corrective Action
Drive is faulted.	Flashing red status light	Clear fault. • Press Stop • Cycle power • Set [Fault Clear] to 1 (See page 3-23) • "Clear Faults" on the HIM Diagnostic menu.
Incorrect input wiring. See pages 1-27 and 1-28 for wiring examples. • 2 wire control requires Run, Run Forward, Run Reverse or Jog input. • 3 wire control requires Start and Stop inputs. • Jumper from terminal 25 to 26 is required.	None	Wire inputs correctly and/or install jumper.
Incorrect digital input programming. • Mutually exclusive choices have been made (i.e., Jog and Jog Forward). • 2 wire and 3 wire programming may be conflicting. • Exclusive functions (i.e, direction control) may have multiple inputs configured. • Stop is factory default and is not wired.	None	Program [Digital Inx Sel] for correct inputs. (See page 3-30) Start or Run programming may be missing.
	Flashing yellow status light and "DigIn CflctB" indication on LCD HIM. [Drive Status 2] shows type 2 alarm(s).	Program [Digital Inx Sel] to resolve conflicts. (See page 3-30) Remove multiple selections for the same function. Install stop button to apply a signal at stop terminal.

Drive does not Start from HIM.

Cause(s)	Indication	Corrective Action
Drive is programmed for 2 wire control. HIM Start button is disabled for 2 wire control.	None	If 2 wire control is required, no action needed. If 3 wire control is required, program [Digital Inx Sel] for correct inputs. (See page 3-30)

Drive does not respond to changes in speed command.

Cause(s)	Indication	Corrective Action
No value is coming from the source of the command.	LCD HIM Status Line indicates “At Speed” and output is 0 Hz.	1. If the source is an analog input, check wiring and use a meter to check for presence of signal. 2. Check [Commanded Freq] for correct source. (See page 3-6)
Incorrect reference source has been programmed.	None	1. Check [Speed Ref Source] for the source of the speed reference. (See page 3-21) 2. Reprogram [Speed Ref A Sel] for correct source. (See page 3-11)
Incorrect Reference source is being selected via remote device or digital inputs.	None	1. Check [Drive Status 1], page 3-20, bits 12 and 13 for unexpected source selections. 2. Check [Dig In Status], page 3-2 to see if inputs are selecting an alternate source. 3. Reprogram digital inputs to correct “Speed Sel x” option. (See page 3-30)

Motor and/or drive will not accelerate to commanded speed.

Cause(s)	Indication	Corrective Action
Acceleration time is excessive.	None	Reprogram [Accel Time x]. (See page 3-15)
Excess load or short acceleration times force the drive into current limit, slowing or stopping acceleration.	None	1. Check [Drive Status 2], bit 10 to see if the drive is in Current Limit. (See page 3-20) 2. Remove excess load or reprogram [Accel Time x]. (See page 3-15)
Speed command source or value is not as expected.	None	Check for the proper Speed Command using Steps 1 through 7 above.
Programming is preventing the drive output from exceeding limiting values.	None	Check [Maximum Speed] (See page 3-10) and [Maximum Freq] (See page 3-7) to assure that speed is not limited by programming.

Motor operation is unstable.

Cause(s)	Indication	Corrective Action
Motor data was incorrectly entered or Autotune was not performed.	None	1. Correctly enter motor nameplate data. 2. Perform “Static” or “Rotate” Autotune procedure. (Param #061, page 3-8)

Drive will not reverse motor direction.

Cause(s)	Indication	Corrective Action
Digital input is not selected for reversing control.	None	Check [Digital Inx Sel], page 3-30. Choose correct input and program for reversing mode.
Digital input is incorrectly wired.	None	Check input wiring. (See page 1-25)
Direction mode parameter is incorrectly programmed.	None	Reprogram [Direction Mode], page 3-19 for analog “Bipolar” or digital “Unipolar” control.
Motor wiring is improperly phased for reverse.	None	Switch two motor leads.
A bipolar analog speed command input is incorrectly wired or signal is absent.	None	1. Use meter to check that an analog input voltage is present. 2. Check wiring. (See page 1-25) Positive voltage commands forward direction. Negative voltage commands reverse direction.

Stopping the drive results in a Decel Inhibit fault.

Cause(s)	Indication	Corrective Action
The bus regulation feature is enabled and is halting deceleration due to excessive bus voltage. Excess bus voltage is normally due to excessive regenerated energy or unstable AC line input voltages. Internal timer has halted drive operation.	Decel Inhibit fault screen. LCD Status Line indicates "Faulted."	1. See Attention statement on page P-3. 2. Reprogram parameters 161/162 to eliminate any "Adjust Freq" selection. 3. Disable bus regulation (parameters 161 & 162) and add a dynamic brake. 4. Correct AC input line instability or add an isolation transformer. 5. Reset drive.

Testpoint Codes and Functions

Select testpoint with [Testpoint x Sel], parameters 234/236. Values can be viewed with [Testpoint x Data], parameters 235/237.

No.(1)	Description	Units	Values		
			Minimum	Maximum	Default
01	DPI Error Status	1	0	255	0
02	Heatsink Temp	0.1 degC	–100.0	100.0	0
03	Active Cur Limit	1	0	32767	0
04	Active PWM Freq	1 Hz	2	10	4
05	Life MegaWatt Hr (2)	0.1 MWh	0	429496729.5	0
06	Life Run Time	0.0001 Hrs	0	429496.7295	0
07	Life Pwr Up Time	0.0001 Hrs	0	429496.7295	0
08	Life Pwr Cycles	1	0	429496729.5	0
09	Life MW-HR Fract (2)	1	0	4294967295	0
10	MW-HR Frac Unit (2)	1	0	4294967295	0
12	Raw Analog In 1	1	0		0
13	Raw Analog In 2	1	0		0
16	CS Msg Rx Cnt	1	0	65535	0
17	CS Msg Tx Cnt	1	0	65535	0
18	CS Timeout Cnt	1	0	255	0
19	CS Msg Bad Cnt	1	0	255	0
22	PC Msg Rx Cnt	1	0	65535	0
23	PC Msg Tx Cnt	1	0	65535	0
24-29	PC1-6 Timeout Cnt	1	0	255	0
30	CAN BusOff Cnt	1	0	65535	0
31	No. of Analog Inputs	1	0		0
32	Raw Temperature	1	0		0
33	MTO Norm Mtr Amp	0.1 Amps	0	65535	0
34	DTO-Cmd DC Hold	1	0	32767	0

(1) Enter in [Testpoint x Sel].

(2) Use the equation below to calculate total Lifetime MegaWatt Hours.

$$\left(\frac{\text{Value of Code 9}}{\text{Value of Code 10}} \times 0.1\right) + \text{Value of Code 5} = \text{Total Lifetime MegaWatt Hours}$$

Test Equipment Needed To Troubleshoot

An isolated multimeter will be needed to measure DC bus voltage and to make resistance checks. Note that dedicated troubleshooting test points are not provided.

Verifying That DC Bus Capacitors Are Discharged

ATTENTION: DC bus capacitors retain hazardous voltages after input power has been disconnected. After disconnecting input power, wait five (5) minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

The LPM15 drive's DC bus capacitors retain hazardous voltages after input power has been disconnected. Perform the following steps before touching any internal components:

1. Turn off and lock out input power. Wait five minutes.
2. Verify that there is no voltage at the drive's input power terminals.
3. Measure the DC bus potential with a voltmeter while standing on a non-conductive surface and wearing insulated gloves (1000 V).

   Measure the DC bus potential at the test points on the Power Interface Control (PIC) board. See Figure 4.2 for B-Frame drives, Figure 4.3 for C-Frame drives, and Figure 4.4 for D-Frame drives. For additional wiring information, refer to Appendix E, Appendix F, or Appendix G.
4. Once the drive has been serviced, reapply input power.

Figure 4.2 DC Bus Voltage Measurement Points for B-Frame Drives

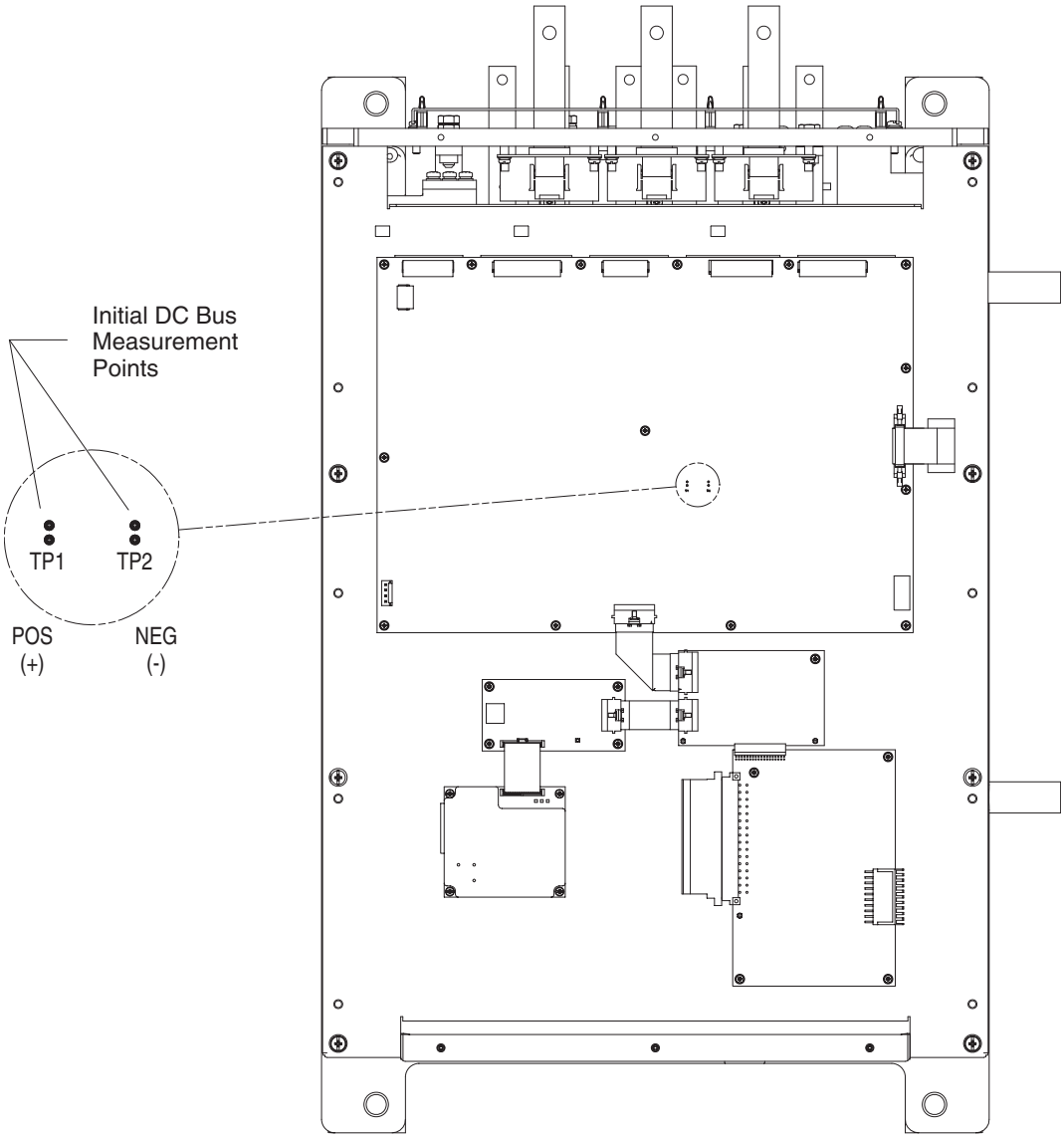


Figure 4.3 DC Bus Voltage Measurement Points for C-Frame Drives

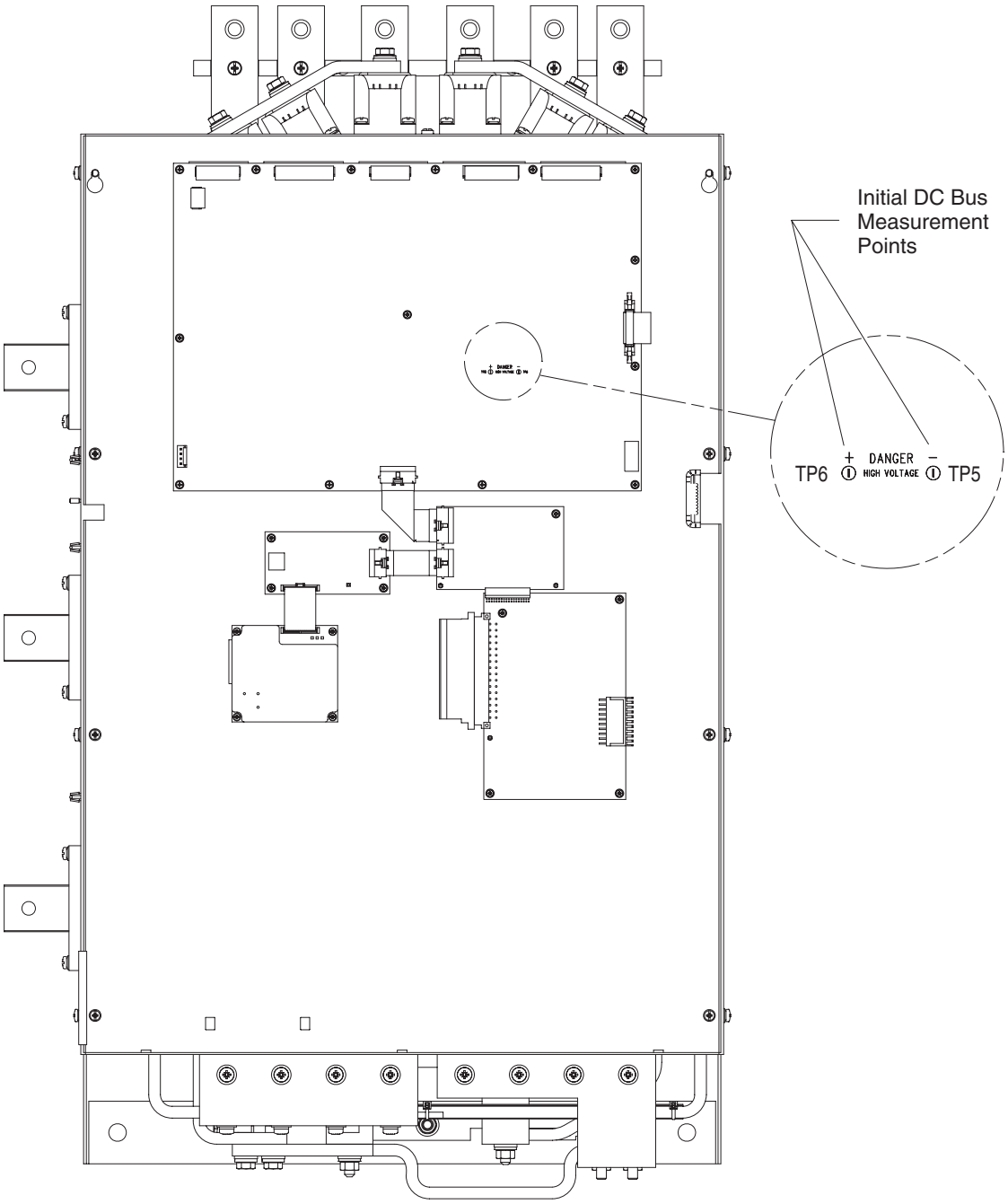
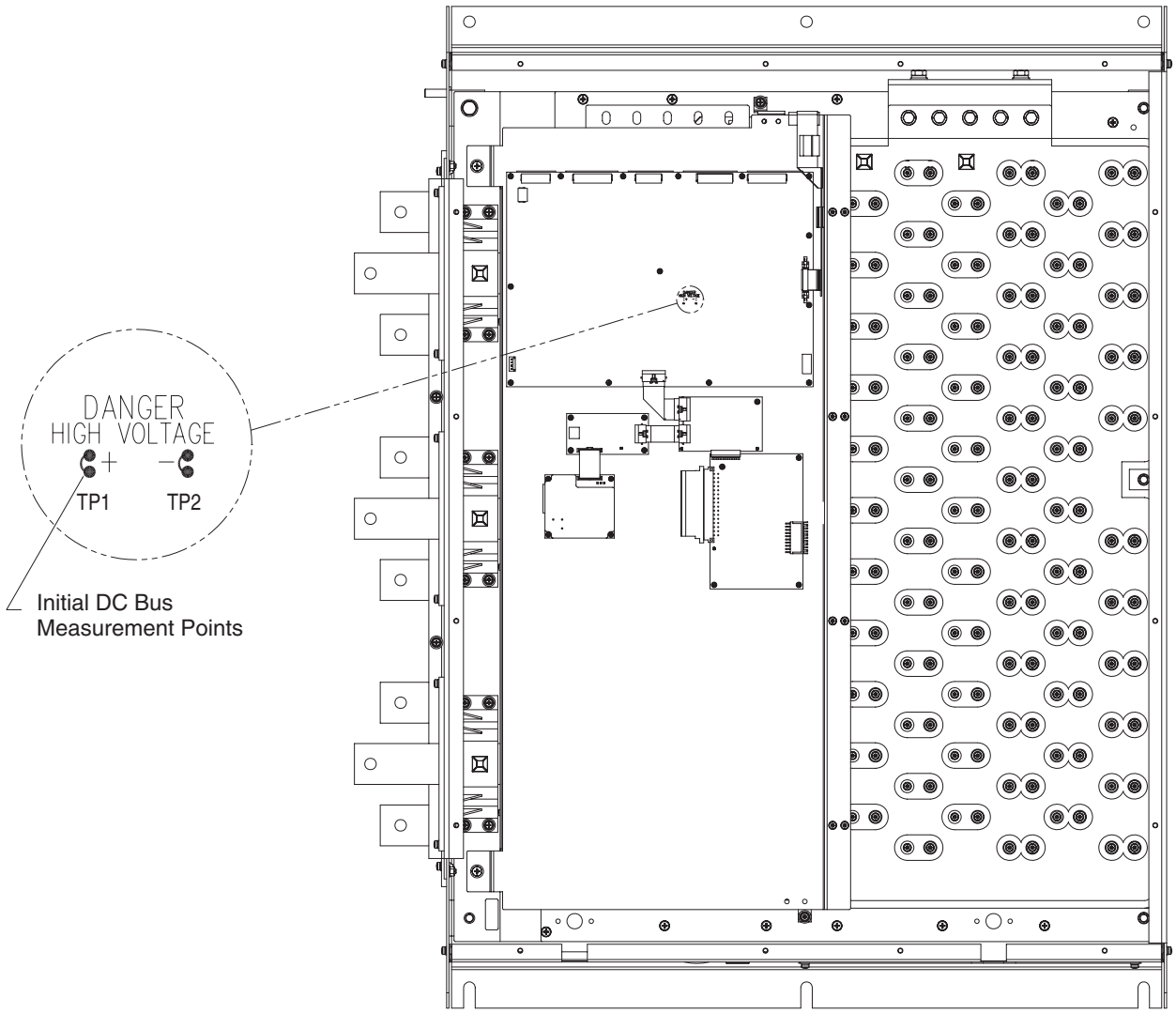


Figure 4.4 DC Bus Voltage Measurement Points for D-Frame Drives



Checking the Power Modules with Input Power Off

Use the following procedure to check the drive's Power Module circuitry with power off:

ATTENTION: DC bus capacitors retain hazardous voltages after input power has been disconnected. After disconnecting input power, wait five (5) minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

1. Turn off and lock out input power. Wait five minutes.
2. Verify that there is no voltage at the drive's input power terminals.
3. Check the DC bus potential with a voltmeter as described on page 4-11 to ensure that the DC bus capacitors are discharged.
4. Disconnect the motor from the drive.
5. Check all AC line and DC bus fuses.
6. If a fuse is open, use a multimeter to check the input diodes and output IGBTs. See Table 4.E.
7. Reconnect the motor to the drive.
8. Reapply input power.

Table 4.E Resistance Checks

Input Diode No.	Meter Connection (+)	Meter Connection (-)	Component is OK if Resistance (R) is:	Component is Defective if:
1	*	L1	10 < R < 1 megohm	Continuity (short circuit) or open when the meter is connected with reversed polarity.
2	*	L2		
3	*	L3		
4	*	L4		
5	*	L5		
6	*	L6		
7	L1	**		
8	L2	**		
9	L3	**		
10	L4	**		
11	L5	**		
12	L6	**		
1	*	W/T3	10 < R < 1 megohm	Continuity (short circuit) or open when the meter is connected with reversed polarity.
2	*	V/T2		
3	*	U/T1		
4	W/T3	**		
5	V/T2	**		
6	U/T1	**		

* (+) DC Bus Volts power terminal

** (-) DC Bus Volts power terminal

Replacement Parts

Table 4.F lists the replacement parts that are available from Allen-Bradley. For printed circuit board (PCB) locations, see Figure 1.1, Figure 1.2, and Figure 1.3.

Table 4.F Drive Replacement Parts

Voltage Class	Drive Current Rating	Description	Catalog Number	Qty. per Drive
480VAC	All ratings	Inverter Control PCB	SK-P1-INVCB-A1	1
480VAC	All ratings	Communication Interface PCB	SK-P1-COMCB-A1	1
480VAC	500A only	450 HP Power Interface Control (PIC) PCB	SK-P1-PICB1-D500	1
480VAC	643A only	600 HP Power Interface Control (PIC) PCB	SK-P1-PICB1-D643	1
480VAC	1200A only	1000 HP Power Interface Control (PIC) PCB	SK-P1-PICB1-D1200	1

Supplemental Drive Information

For information on…	See page…
Specifications	A-1
Communication Configurations	A-3

Specifications

Category	Specification	
Agency Certification	c UL us	Listed to UL508C and CAN/CSA-C2.2 No. 14-M91.
	CE	Marked for all applicable European Directives(1): EMC Directive (89/336/EEC) EN 61800-3 Adjustable Speed electrical power drive systems Low Voltage Directive (73/23/EEC) EN 50178 Electronic Equipment for use in Power Installations
	The drive is also designed to meet the following specifications: NFPA 70 - US National Electrical Code NEMA ICS 3.1 - Safety standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems IEC 146 - International Electrical Code	

(1) Applied noise impulses may be counted in addition to the standard pulse train causing erroneously high [Pulse Freq] readings.

Category	Specification	
Protection	**Drive**	480V
	AC Input Overvoltage Trip:	570VAC
	AC Input Undervoltage Trip:	280VAC
	Bus Overvoltage Trip:	810VDC
	Bus Undervoltage Shutoff/Fault:	305VDC
	Nominal Bus Voltage:	648VDC
	All Drives	
	Heat Sink Thermistor:	Monitored by microprocessor overtemp trip
	Drive Overcurrent Trip Software Overcurrent Trip: Hardware Overcurrent Trip:	 200% of rated current (typical) 220-300% of rated current (dependent on drive rating)
	Line Transients:	up to 6000 volts peak per IEEE C62.41-1991
	Control Logic Noise Immunity:	Showering arc transients up to 1500V peak
	Power Ride-Thru:	15 milliseconds at full load
	Logic Control Ride-Thru:	0.5 seconds minimum, 2 seconds typical
	Ground Fault Trip:	Phase-to-ground on drive output
	Short Circuit Trip:	Phase-to-phase on drive output
Environment	Altitude:	1000 m (3300 ft) max. without derating
	Maximum Surrounding Air Temperature without Derating: IP20, NEMA Type 1:	 0 to 40°C (32 to 104°F)
	Storage Temperature (all constructions):	–40 to 70°C (–40 to 158°F)

Category	Specification	
Environment *(continued)*	Atmosphere:	**Important:** Drive **must not** be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere.
	Relative Humidity:	5 to 95% non-condensing
	Shock:	15G peak for 11ms duration (± 1.0 ms)
	Vibration:	0.152 mm (0.006 in.) displacement, 1G peak
Electrical	Voltage Tolerance:	See page D-14 for full power and operating range.
	Frequency Tolerance:	47-63 Hz.
	Input Phases:	Three-phase input provides full rating for all drives. Single-phase operation provides 50% of rated current.
	Displacement Power Factor:	0.98 across entire speed range
	Efficiency:	97.5% at rated amps, nominal line volts
	Maximum Short Circuit Rating:	85,000 Amps symmetrical
	Actual Short Circuit Rating:	Determined by AIC rating of installed fuse/circuit breaker.
Control	Method:	Sine coded PWM with programmable carrier frequency. Ratings apply to all drives (refer to the *Derating Guidelines* in the PowerFlex Reference Manual). The drive can be supplied as 6 pulse or 12 pulse in a configured package.
	Carrier Frequency:	2, 3 or 4 kHz. Drive rating based on 2 kHz.
	Output Voltage Range:	0 to rated motor voltage
	Output Frequency Range:	Standard Control – 0 to 400 Hz.
	Frequency Accuracy Digital Input: Analog Input:	 Within ± 0.01% of set output frequency. Within ± 0.4% of maximum output frequency.
	Frequency Control:	Speed Regulation - w/Slip Compensation (Volts per Hertz Mode) 0.5% of base speed across 40:1 speed range 40:1 operating range 10 rad/sec bandwidth
		Speed Regulation - w/Slip Compensation (Sensorless Vector Mode) 0.5% of base speed across 80:1 speed range 80:1 operating range 20 rad/sec bandwidth
	Selectable Motor Control:	Sensorless Vector with full tuning. Standard V/Hz with full custom capability.
	Stop Modes:	Multiple programmable stop modes including Ramp, Coast, DC-Brake, Ramp-to-Hold, and S-curve.
	Accel/Decel:	Two independently programmable accel and decel times. Each time may be programmed from 0 - 3600 seconds in 0.1 second increments.
	Intermittent Overload:	110% Overload capability for up to 1 minute. 150% Overload capability for up to 3 seconds.
	Current Limit Capability:	Proactive Current Limit programmable from 20 to 160% of rated output current. Independently programmable proportional and integral gain.
	Electronic Motor Overload Protection:	Class 10 protection with speed sensitive response. Investigated by U.L. to comply with N.E.C. Article 430. U.L. File E59272, volume 12.

Communication Configurations

Typical Programmable Controller Configurations

Important: If block transfers are programmed to continuously write information to the drive, care must be taken to properly format the block transfer. If attribute 10 is selected for the block transfer, values will be written only to RAM and will not be saved by the drive. This is the preferred attribute for continuous transfers. If attribute 9 is selected, each program scan will complete a write to the drives non-volatile memory (EEprom). Since the EEprom has a fixed number of allowed writes, continuous block transfers will quickly damage the EEprom. Do Not assign attribute 9 to continuous block transfers. Refer to the individual communications adapter User Manual for additional details.

Logic Command/Status Words

Table A.A Logic Command Word

Logic Bits															Command	Description
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
															x	Stop (1)	0 = Not Stop 1 = Stop
														x		Start (1) (2)	0 = Not Start 1 = Start
													x			Jog	0 = Not Jog 1 = Jog
												x				Clear Faults	0 = Not Clear Faults 1 = Clear Faults
										x	x					Direction	00 = No Command 01 = Forward Command 10 = Reverse Command 11 = Hold Present Direction
									x							Local Control	0 = No Local Control 1 = Local Control
								x								MOP Increment	0 = Not Increment 1 = Increment
						x	x									Accel Rate	00 = No Command 01 = Use Accel Time 1 10 = Use Accel Time 2 11 = Use Present Time
				x	x											Decel Rate	00 = No Command 01 = Use Decel Time 1 10 = Use Decel Time 2 11 = Use Present Time
	x	x	x													Reference Select (3)	000 = No Command 001 = Ref. 1 (Ref A Select) 010 = Ref. 2 (Ref B Select) 011 = Ref. 3 (Preset 3) 100 = Ref. 4 (Preset 4) 101 = Ref. 5 (Preset 5) 110 = Ref. 6 (Preset 6) 111 = Ref. 7 (Preset 7)
x																MOP Decrement	0 = Not Decrement 1 = Decrement

(1) A "0 = Not Stop" condition (logic 0) must first be present before a "1 = Start" condition will start the drive. The Start command acts as a momentary Start command. A "1" will start the drive, but returning to "0" will not stop the drive.

(2) This Start will not function if a digital input (parameters 361-366) is programmed for 2-Wire Control (option 7, 8 or 9).

(3) This Reference Select will not function if a digital input (parameters 361-366) is programmed for "Speed Sel 1, 2 or 3" (option 15, 16 or 17). Note that Reference Selection is "Exclusive Ownership" see [Reference Owner] on page 3-26.

Table A.B Logic Status Word

Logic Bits															Status	Description
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
															x	Ready	0 = Not Ready 1 = Ready
														x		Active	0 = Not Active 1 = Active
													x			Command Direction	0 = Reverse 1 = Forward
												x				Actual Direction	0 = Reverse 1 = Forward
											x					Accel	0 = Not Accelerating 1 = Accelerating
										x						Decel	0 = Not Decelerating 1 = Decelerating
									x							Alarm	0 = No Alarm 1 = Alarm
								x								Fault	0 = No Fault 1 = Fault
							x									At Speed	0 = Not At Reference 1 = At Reference
				x	x	x										Local Control[1]	000 = Port 0 (TB) 001 = Port 1 010 = Port 2 011 = Port 3 100 = Port 4 101 = Port 5 110 = Reserved 111 = No Local
x	x	x	x													Reference Source	0000 = Ref A Auto 0001 = Ref B Auto 0010 = Preset 2 Auto 0011 = Preset 3 Auto 0100 = Preset 4 Auto 0101 = Preset 5 Auto 0110 = Preset 6 Auto 0111 = Preset 7 Auto 1000 = Term Blk Manual 1001 = DPI 1 Manual 1010 = DPI 2 Manual 1011 = DPI 3 Manual 1100 = DPI 4 Manual 1101 = DPI 5 Manual 1110 = Reserved 1111 = Jog Ref

(1) See “Owners” on page 3-25 for further information.

Technical Specifications

Table B.A Service Conditions

AC Line Distribution System Capacity (maximum) for 460 VAC Units:	85,000 amps symmetrical fault current capacity. Short circuit rating may be limited to 65,000 amps if a circuit breaker is used instead of fuses.
Control Method:	All-digital vector, sinusoidal pulse-width-modulated (PWM)
Displacement Power Factor:	0.96
Line Frequency:	50/60Hz (± 2 Hz)
Line Voltage Variation:	-10% to +10%
Line Dip Ride-Through:	V/Hz, SVC: Adjustable from 0 to 60 seconds (see parameter 185)
Motor Lead Lengths:	76 meters (250 feet) total
Remote Operator Control Wire Length:	Up to 303 meters (1000 feet) from the drive
Analog Speed Reference Resolution:	1/1024 (10 bits) 0.1%
Acceleration Adjustment Range:	0.1 to 999.9 seconds (within the ability of current)
Carrier Frequency:	2 kHz, 4 kHz, or 8 kHz (software-selectable)
Current Limit Adjustment:	V/Hz: 50% to 110% (based on drive nameplate rating)
Service Factor:	1.0
Speed Adjustable Range:	From 0 RPM to maximum speed
Speed Regulation:	V/Hz: Motor slip dependent
Speed Reference Resolution:	1 RPM with local keypad, -4095 to +4095 counts with a network or serial reference
Torque Control Response:	180 to 220 Hz
Torque Linearity:	+3% with optimal parameter setting (typical)

Table B.B Environmental Conditions

Condition	Specification
Operating Temperature (inside an enclosure):	0 to 55°C [1] (32 to 131°F)
Storage Temperature (Ambient):	-40 to 65°C (-40 to 149°F)
Humidity:	5% to 95% (non-condensing)

[1] User-supplied cabinet air cooling system must provide adequate heat dissipation to maintain an internal temperature not to exceed 55° C. Refer to Table 1.A for drive air watts loss.

Notes:

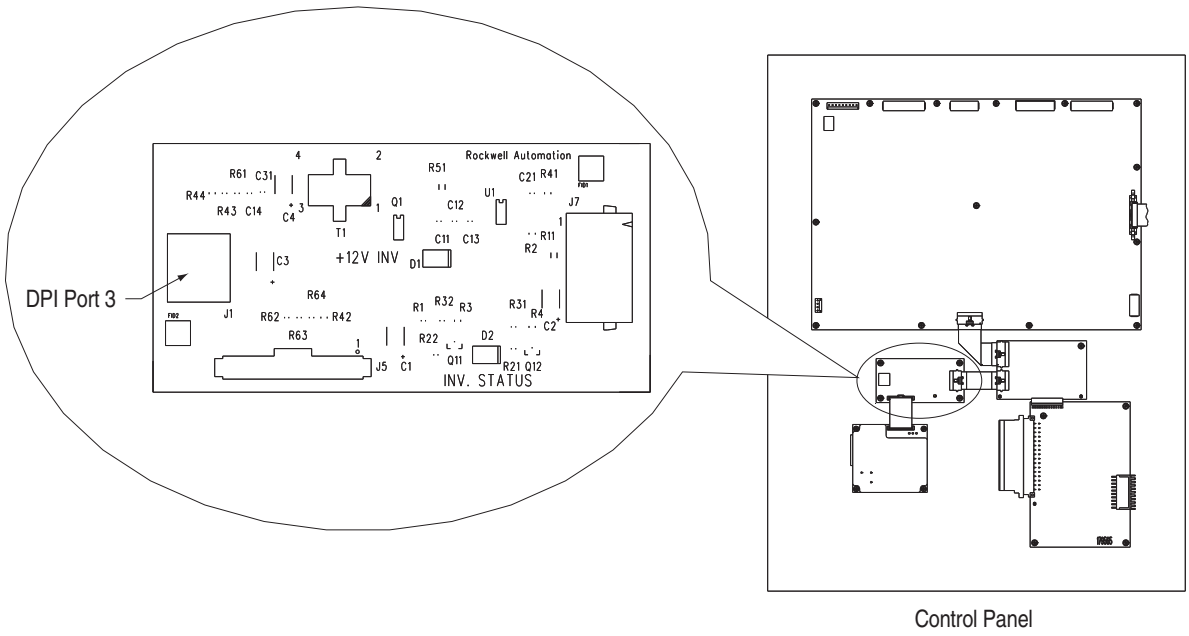
HIM Overview

For information on...	See page...
Remote HIM Connection	C-1
LCD Display Elements	C-2
ALT Functions	C-2
Menu Structure	C-3
Viewing and Editing Parameters	C-5
Removing/Installing the HIM	C-6

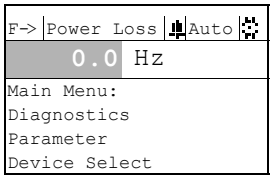
Remote HIM Connection

The LPM15 provides a cable connection point (DPI Port 3) for a remote HIM.

Figure C.1 DPI Port 3 Location for Remote HIM Connection



LCD Display Elements

Display	Description
	Direction | Drive Status | Alarm | Auto/Man | Information Commanded or Output Frequency Programming / Monitoring / Troubleshooting

ALT Functions

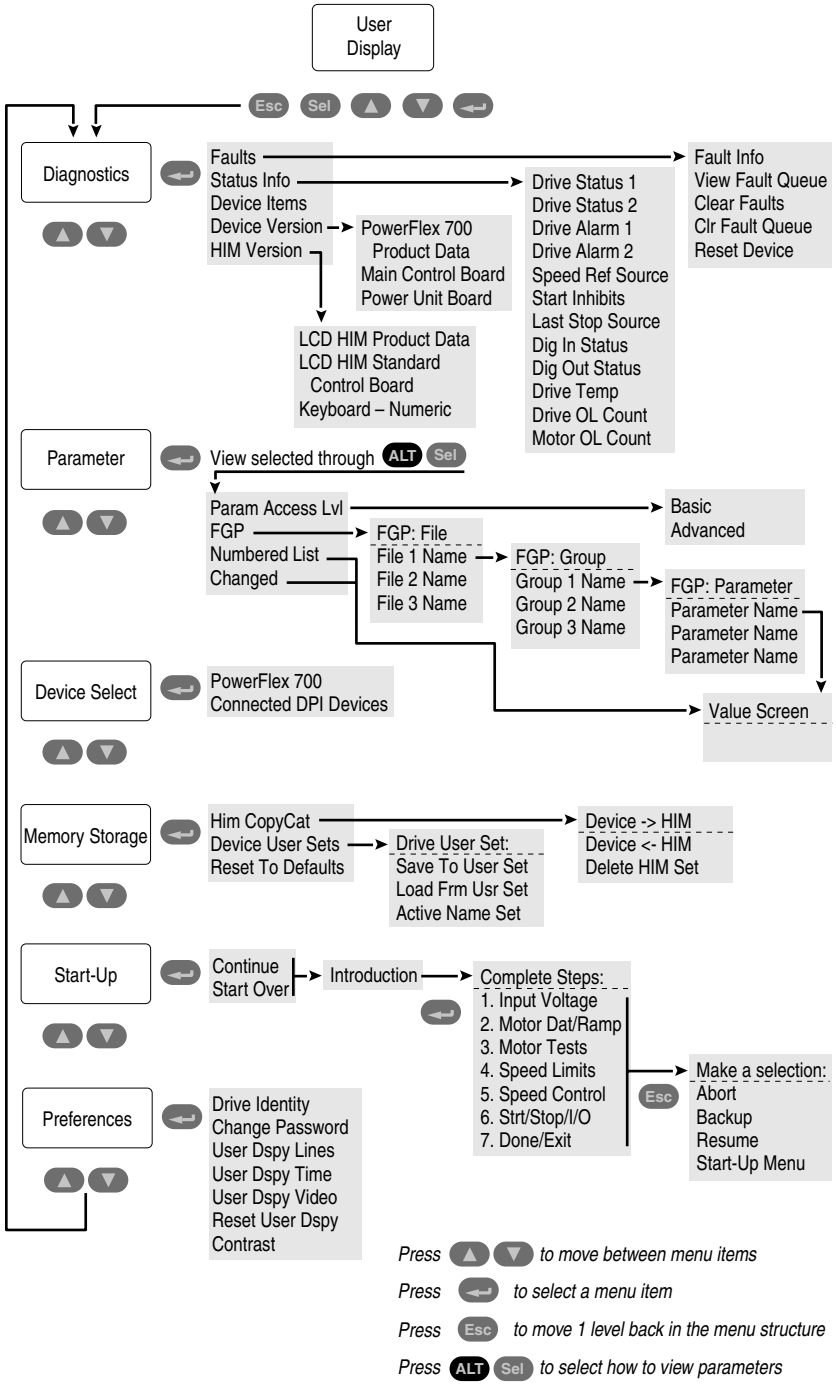
To use an ALT function, press the ALT key, release it, then press the programming key associated with one of the following functions:

Table C.A ALT Key Functions

ALT Key and then …			Performs this function …
ALT	Esc	S.M.A.R.T.	Displays the S.M.A.R.T. screen.
	Sel	View	Allows the selection of how parameters will be viewed or detailed information about a parameter or component.
	▲	Lang	Displays the language selection screen.
	▼	Auto / Man	Switches between Auto and Manual Modes.
	↵	Remove	Allows HIM removal without causing a fault if the HIM is not the last controlling device and does not have Manual control of the drive.
	.	Exp	Allows value to be entered as an exponent. (Not available on LPM15.)
	+/–	Param #	Allows entry of a parameter number for viewing/editing.

Menu Structure

Figure C.2 HIM Menu Structure



Diagnostics Menu

When a fault trips the drive, use this menu to access detailed data about the drive.

Option	Description
Faults	View fault queue or fault information, clear faults or reset drive.
Status Info	View parameters that display status information about the drive.
Device Version	View the firmware version and hardware series of components.
HIM Version	View the firmware version and hardware series of the HIM.

Parameter Menu

Refer to Viewing and Editing Parameters on page C-5.

Device Select Menu

Use this menu to access parameters in connected peripheral devices.

Memory Storage Menu

Drive data can be saved to, or recalled from, User and HIM sets.
User sets are files stored in permanent non-volatile drive memory.
HIM sets are files stored in permanent non-volatile HIM memory.

Option	Description
HIM Copycat Device -->HIM Device <-- HIM	Save data to a HIM set, load data from a HIM set to active drive memory or delete a HIM set.
Device User Sets	Save data to a User set, load data from a User set to active drive memory or name a User set.
Reset To Defaults	Restore the drive to its factory-default settings.

Start Up Menu

See Chapter 2.

Preferences Menu

The HIM and drive have features that you can customize.

Option	Description
Drive Identity	Add text to identify the drive.
Change Password	Enable/disable or modify the password.
User Dspy Lines	Select the display, parameter, scale and text for the User Display. The User Display is two lines of user-defined data that appears when the HIM is not being used for programming.
User Dspy Time	Set the wait time for the User Display or enable/disable it.
User Dspy Video	Select Reverse or Normal video for the Frequency and User Display lines.
Reset User Dspy	Return all the options for the User Display to factory default values.

The LPM15 drive is initially set to Basic Parameter View. To view all parameters, set parameter 196 [Param Access Lvl] to option “1” (Advanced). Parameter 196 is not affected by the Reset to Defaults function.

Viewing and Editing Parameters

LCD HIM

Step	Key(s)	Example Displays
1. In the Main Menu, press the Up Arrow or Down Arrow to scroll to "Parameter."	▲ or ▼	FGP: File Monitor Motor Control Speed Reference
2. Press Enter. "FGP File" appears on the top line and the first three files appear below it.	↵	
3. Press the Up Arrow or Down Arrow to scroll through the files.	▲ or ▼	FGP: Group Motor Data Torq Attributes Volts per Hertz
4. Press Enter to select a file. The groups in the file are displayed under it.	↵	
5. Repeat steps 3 and 4 to select a group and then a parameter. The parameter value screen will appear.		FGP: Parameter Maximum Voltage Maximum Freq Compensation
6. Press Enter to edit the parameter.	↵	
7. Press the Up Arrow or Down Arrow to change the value. If desired, press Sel to move from digit to digit, letter to letter, or bit to bit. The digit or bit that you can change will be highlighted.	▲ or ▼ Sel	FGP: Par 55 Maximum Freq 60.00 Hz 25 <> 400.00
8. Press Enter to save the value. If you want to cancel a change, press Esc.	↵	
9. Press the Up Arrow or Down Arrow to scroll through the parameters in the group, or press Esc to return to the group list.	▲ or ▼ Esc	FGP: Par 55 Maximum Freq 90.00 Hz 25 <> 400.00

Numeric Keypad Shortcut

If using a HIM with a numeric keypad, press the ALT key and the +/– key to access the parameter by typing its number.

Removing/Installing the HIM

The HIM can be removed or installed while the drive is powered.

Important: HIM removal is only permissible in Auto mode. If the HIM is removed while in Manual mode or the HIM is the only remaining control device, a fault will occur.

Step	Key(s)	Example Displays
To remove the HIM… 1. Press ALT and then Enter (Remove). The Remove HIM confirmation screen appears. 2. Press Enter to confirm that you want to remove the HIM. 3. Disconnect the HIM from the drive. To install HIM… 1. Connect the HIM cable to the drive (DPI Port 3).		Remove Op Intrfc: Press Enter to Disconnect Op Intrfc? (Port 1 Control)

Application Notes

For information on...	See page...
Minimum Speed	D-1
Motor Control Technology	D-1
Motor Overload	D-2
Overspeed	D-4
Power Loss Ride Through	D-4
Process PI	D-6
Reverse Speed Limit	D-8
Skip Frequency	D-9
Sleep Wake Mode	D-10
Start At PowerUp	D-11
Stop Mode	D-12
Voltage Tolerance	D-14

Minimum Speed

Refer to Reverse Speed Limit on page D-8.

Motor Control Technology

The LPM15 drive provides several motor control technologies:

- Torque Producer
- Speed Regulator

Torque Producer

Volts/Hertz

This technology follows a specific pattern of voltage and frequency output to the motor, regardless of the motor being used. The shape of the V/Hz curve can be controlled a limited amount, but once the shape is determined, the drive output is fixed to those values. Given the fixed values, each motor will react based on its own speed/torque characteristics.

This technology is good for basic centrifugal fan/pump operation and for most multi-motor applications. Torque production is generally good.

Sensorless Vector

This technology combines the basic Volts/Hertz concept with known motor parameters such as Rated FLA, HP, Voltage, stator resistance and flux producing current. Knowledge of the individual motor attached to the drive allows the drive to adjust the output pattern to the motor and load

conditions. By identifying motor parameters, the drive can maximize the torque produced in the motor and extend the speed range at which that torque can be produced.

This technology is excellent for applications that require a wider speed range and applications that need maximum possible torque for breakaway, acceleration or overload. Centrifuges, extruders, conveyors and others are candidates.

Speed Regulator

The LPM15 drive, regardless of its motor control technology (Volts/Hz or Sensorless Vector) can be set up to regulate speed. Speed regulation and torque regulation must be separated to understand drive operation.

The LPM15 can be programmed to regulate speed using the slip compensation feature. Slip compensation reacts to load changes by adjusting the drive output frequency to maintain motor speed. Torque production operates independently. This feature produces speed regulation of about 0.5% of base speed over a specified speed range (40:1 for V/Hz and 80:1 for Sensorless Vector). The LPM15 drive does not have the capability to extend the speed range or tighten the speed regulation below 0.5% because it does not have connections for a feedback device.

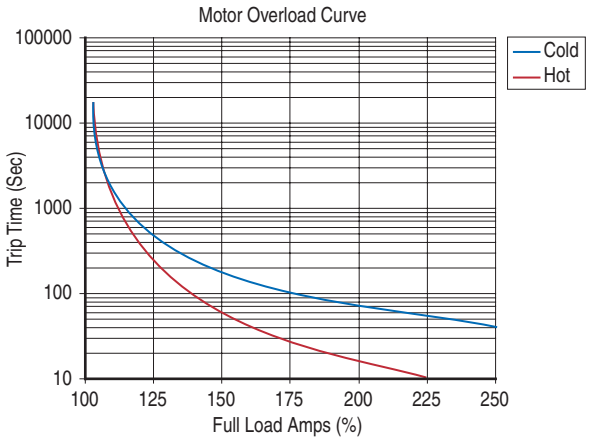
Motor Overload

For single motor applications the drive can be programmed to protect the motor from overload conditions. An electronic thermal overload I^2T function emulates a thermal overload relay. This operation is based on three parameters; [Motor NP FLA], [Motor OL Factor] and [Motor OL Hertz] (parameters 042, 048 and 047, respectively).

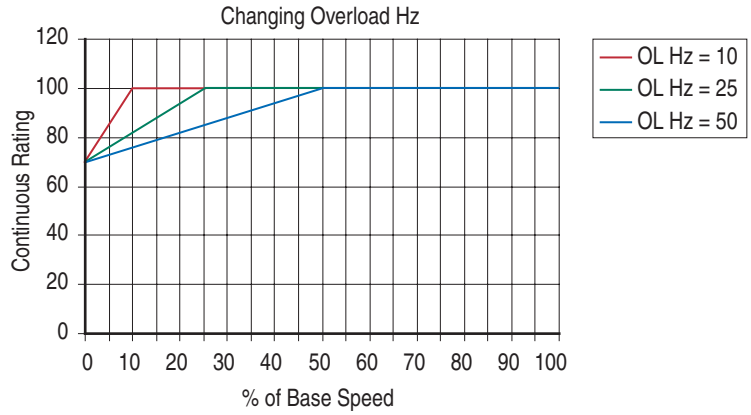
[Motor NP FLA] is multiplied by [Motor OL Factor] to allow the user to define the continuous level of current allowed by the motor thermal overload. [Motor OL Hertz] is used to allow the user to adjust the frequency below which the motor overload is derated.

The motor can operate up to 102% of FLA continuously. If the drive had just been activated, it will run at 150% of FLA for 180 seconds. If the motor had been operating at 100% for over 30 minutes, the drive will run at 150% of FLA for 60 seconds. These values assume the drive is operating above [Motor OL Hertz], and that [Motor OL Factor] is set to 1.00.

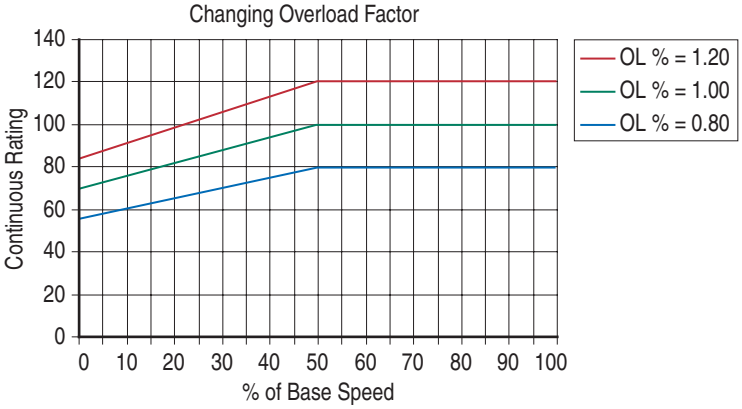
Operation below 100% current causes the temperature calculation to account for motor cooling.



[Motor OL Hertz] defines the frequency where motor overload capacity derate should begin. The motor overload capacity is reduced when operating below [Motor OL Hertz]. For all settings of [Motor OL Hertz] other than zero, the overload capacity is reduced to 70% at an output frequency of zero.



[Motor NP FLA] is multiplied by [Motor OL Factor] to select the rated current for the motor thermal overload. This can be used to raise or lower the level of current that will cause the motor thermal overload to trip. The effective overload factor is a combination of [Motor OL Hertz] and [Motor OL Factor].



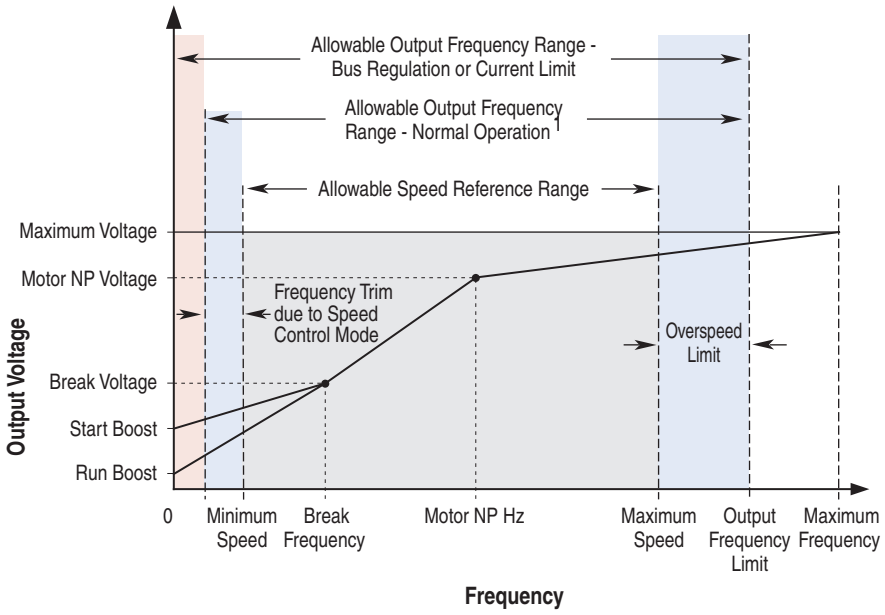
Overspeed

Overspeed Limit is a user-programmable value that allows operation at maximum speed, but also provides an "overspeed band" that will allow a speed regulator such as slip compensation to increase the output frequency above maximum speed in order to maintain maximum motor speed.

The figure below illustrates a typical Custom V/Hz profile. Minimum Speed is entered in Hertz and determines the lower speed reference limit during normal operation. Maximum Speed is entered in Hertz and determines the upper speed reference limit. The two "Speed" parameters only limit the speed reference and not the output frequency.

The actual output frequency at maximum speed reference is the sum of the speed reference plus "speed adder" components from functions such as slip compensation.

The Overspeed Limit is entered in Hertz and added to Maximum Speed and the sum of the two (Speed Limit) limit the output frequency. This sum (Speed Limit) is compared to Maximum Frequency and an alarm is initiated which prevents operation if the Speed Limit exceeds Maximum Frequency.



Note 1: The lower limit on this range can be 0 depending on the value of Speed Adder

Power Loss Ride Through

When AC input power is lost, energy is being supplied to the motor from the DC bus capacitors. The energy from the capacitors is not being replaced (via the AC line), thus, the DC bus voltage will fall rapidly. The drive must detect this fall and react according to the way it is programmed. Two parameters display DC bus voltage:

- [DC Bus Voltage] - displays the instantaneous value
- [DC Bus Memory] - displays a 6 minute running average of the voltage.

All drive reactions to power loss are based on [DC Bus Memory]. This averages low and high line conditions and sets the drive to react to the

average rather than assumed values. For example, a 480V installation would have a 480V AC line and produce a nominal 648V DC bus. If the drive were to react to a fixed voltage for line loss detect, (i.e. 533V DC), then normal operation would occur for nominal line installations. However, if a lower nominal line voltage of 440V AC was used, then nominal DC bus voltage would be only 594V DC. If the drive were to react to the fixed 533V level (only –10%) for line loss detect, any anomaly might trigger a false line loss detection. Line loss, therefore always uses the 6 minute average for DC bus voltage and detects line loss based on a fixed percentage of that memory. In the same example, the average would be 594V DC instead of 650V DC and the fixed percentage, 27% for “Coast to Stop” and 18% for all others, would allow identical operation regardless of line voltage.

The LPM15 can selectively use the same percentages or the user can set a trigger point for line loss detect. The adjustable trigger level is set using [Power Loss Level] (see [Power Loss Level] on page 3-18).

Figure D.1 Power Loss Mode = Coast

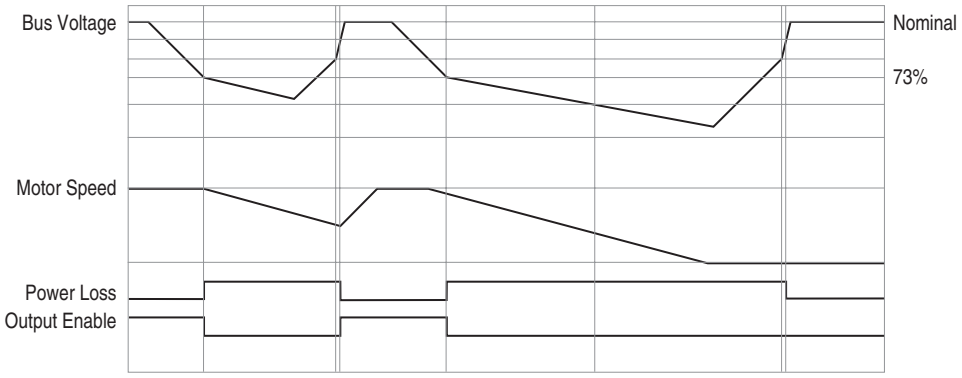
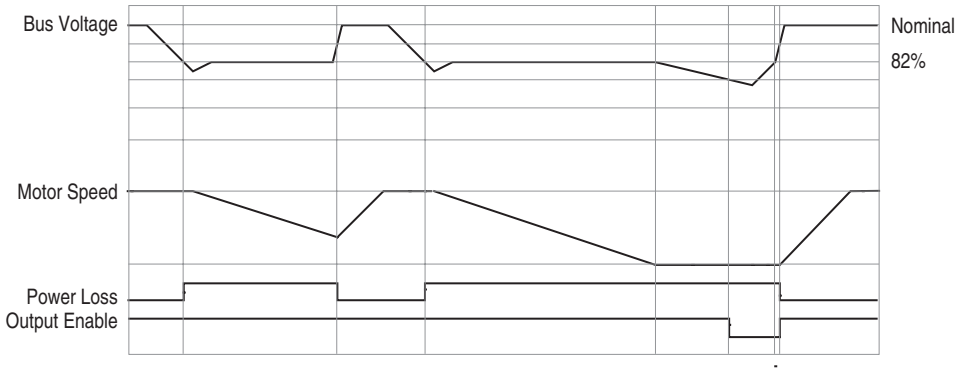


Figure D.2 Power Loss Mode = Decel

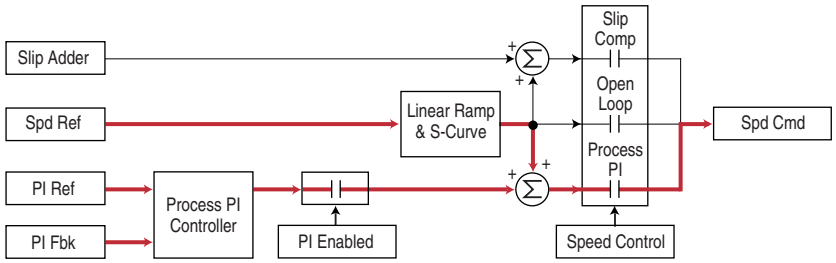


Process PI

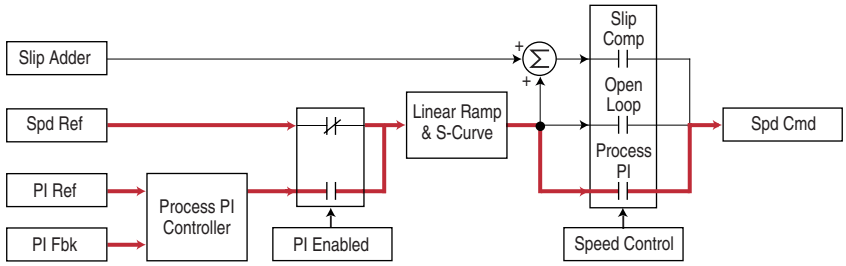
The internal PI function of the LPM15 provides closed loop process control with proportional and integral control action. The function is designed for use in applications that require simple control of a process without external control devices. The PI function allows the microprocessor of the drive to follow a single process control loop.

The PI function reads a process variable input to the drive and compares it to a desired setpoint stored in the drive. The algorithm will then adjust the output of the PI regulator, changing drive output frequency to try and make the process variable equal the setpoint.

It can operate as trim mode by summing the PI loop output with a master speed reference.

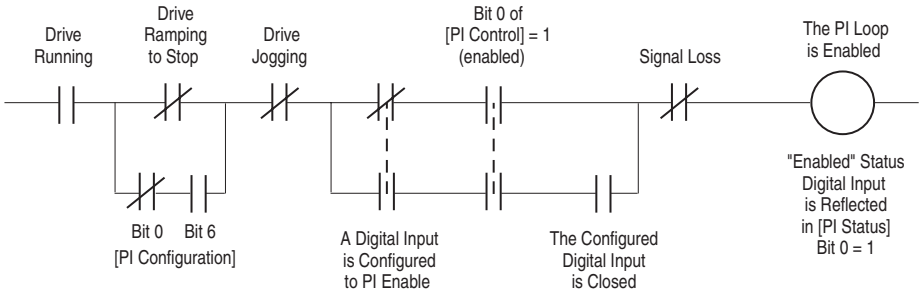


Or, it can operate as control mode by supplying the entire speed reference. This method is identified as “exclusive mode.”



PI Enable

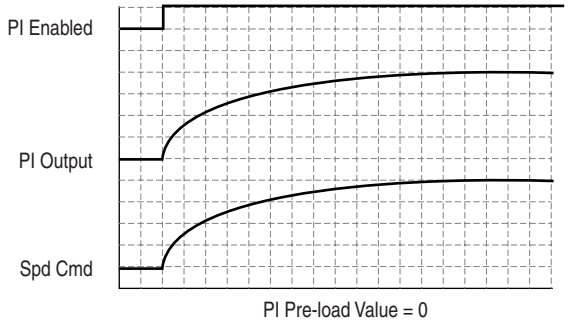
The output of the PI loop can be turned on (enabled) or turned off (disabled). This control allows the user to determine when the PI loop is providing part or all of the commanded speed. The logic for enabling the PI loop is shown below.


Drive Running
Drive Ramping to Stop
Drive Jogging
Bit 0 of [PI Control] = 1 (enabled)
Signal Loss
The PI Loop is Enabled
Bit 0
Bit 6
[PI Configuration]
A Digital Input is Configured to PI Enable
The Configured Digital Input is Closed
"Enabled" Status Digital Input is Reflected in [PI Status] Bit 0 = 1

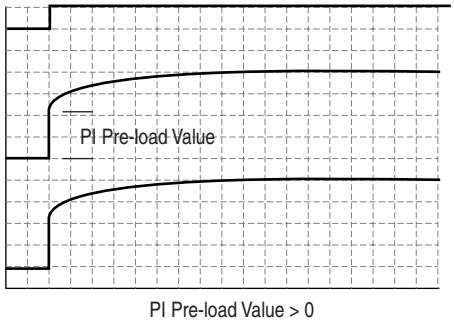
The drive must be running for the PI loop to be enabled. The loop will be disabled when the drive is ramping to a stop (unless “Stop Mode” is configured in [PI Configuration]), jogging or the signal loss protection for the analog input(s) is sensing a loss of signal.

If a digital input has been configured to “PI Enable,” two events are required to enable the loop: the digital input must be closed AND bit 0 of the PI Control parameter must be = 1.

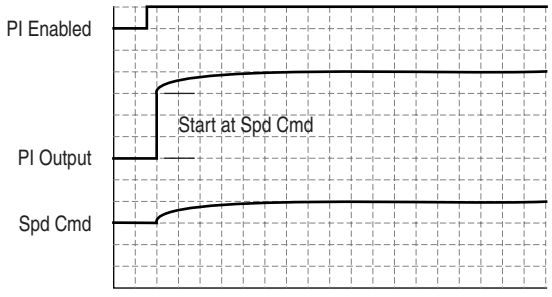
If no digital input is configured to “PI Enable,” then only the Bit 0 = 1 condition must be met. If the bit is permanently set to a “1”, then the loop will become enabled as soon as the drive goes into “run.”



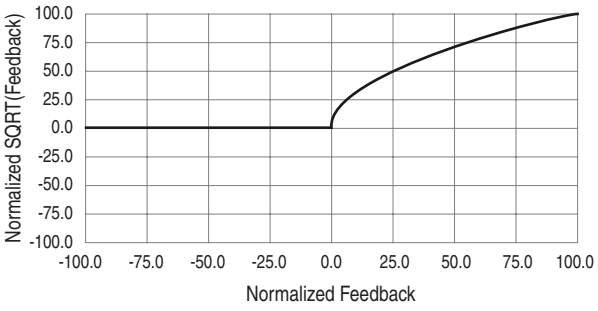
PI Pre-load Value = 0

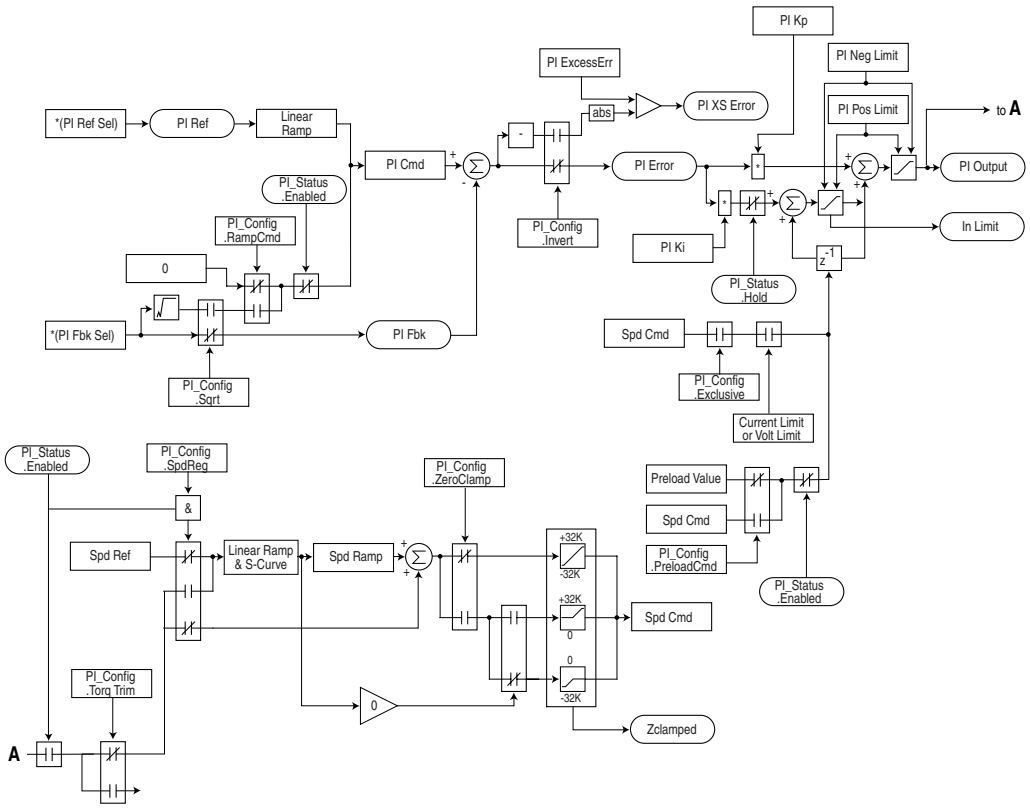


PI Pre-load Value > 0



Pre-load to Command Speed





Reverse Speed Limit

Figure D.3 [Rev Speed Limit], parameter 454 set to zero

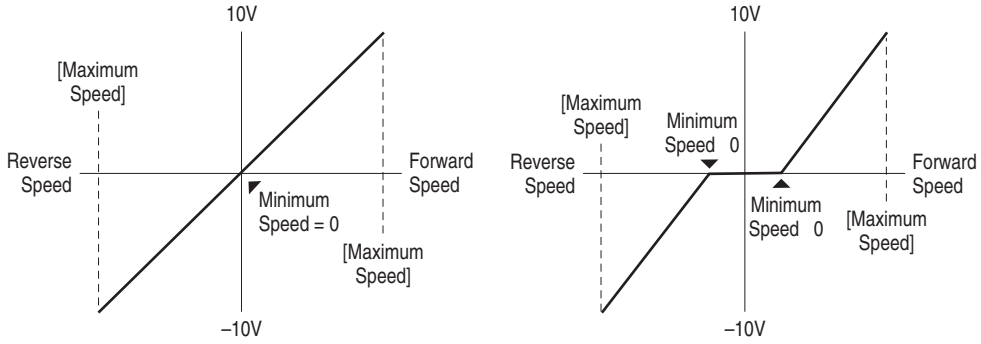
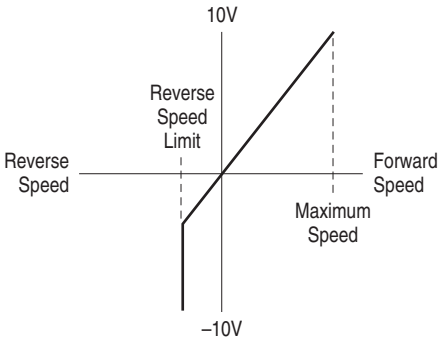
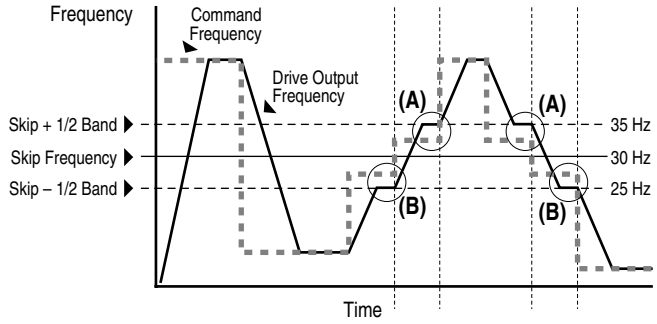


Figure D.4 [Rev Speed Limit], parameter 454 set to a non-zero Value



Skip Frequency

Figure D.5 Skip Frequency



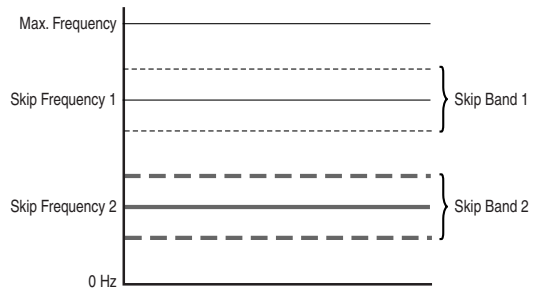
Some machinery may have a resonant operating frequency that must be avoided to minimize the risk of equipment damage. To assure that the motor cannot continuously operate at one or more of the points, skip frequencies are used. Parameters 084-086, ([Skip Frequency 1-3]) are available to set the frequencies to be avoided.

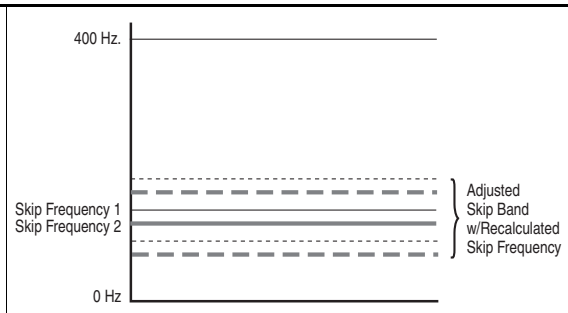
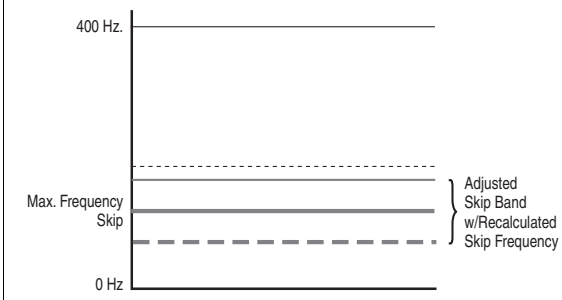
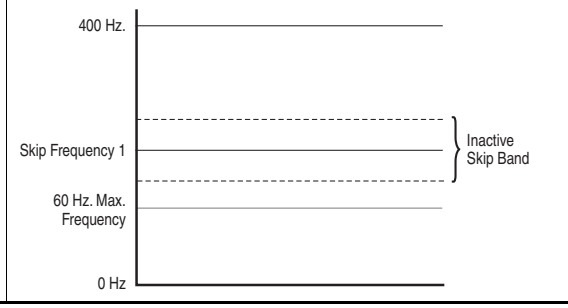
The value programmed into the skip frequency parameters sets the center point for an entire “skip band” of frequencies. The width of the band (range of frequency around the center point) is determined by parameter 87, [Skip Freq Band]. The range is split, half above and half below the skip frequency parameter.

If the commanded frequency of the drive is greater than or equal to the skip (center) frequency and less than or equal to the high value of the band (skip plus 1/2 band), the drive will set the output frequency to the high value of the band. See (A) in Figure D.5.

If the commanded frequency is less than the skip (center) frequency and greater than or equal to the low value of the band (skip minus 1/2 band), the drive will set the output frequency to the low value of the band. See (B) in Figure D.5.

Acceleration and deceleration are not affected by the skip frequencies. Normal accel/decel will proceed through the band once the commanded frequency is greater than the skip frequency. See (A) & (B) in Figure D.5. This function affects only continuous operation within the band.

Skip Frequency Examples	
The skip frequency will have hysteresis so the output does not toggle between high and low values. Three distinct bands can be programmed. If none of the skip bands touch or overlap, each band has its own high/low limit.	

Skip Frequency Examples	
If skip bands overlap or touch, the center frequency is recalculated based on the highest and lowest band values.	
If a skip band(s) extend beyond the max frequency limits, the highest band value will be clamped at the max frequency limit. The center frequency is recalculated based on the highest and lowest band values.	
If the band is outside the limits, the skip band is inactive.	

Sleep Wake Mode

This function stops (sleep) and starts (wake) the drive based on separately configurable analog input levels rather than discrete start and stop signals. When enabled in “Direct” mode, the drive will start (wake) when an analog signal is greater than or equal to the user specified [Wake Level], and stop the drive when an analog signal is less than or equal to the user specified [Sleep Level].

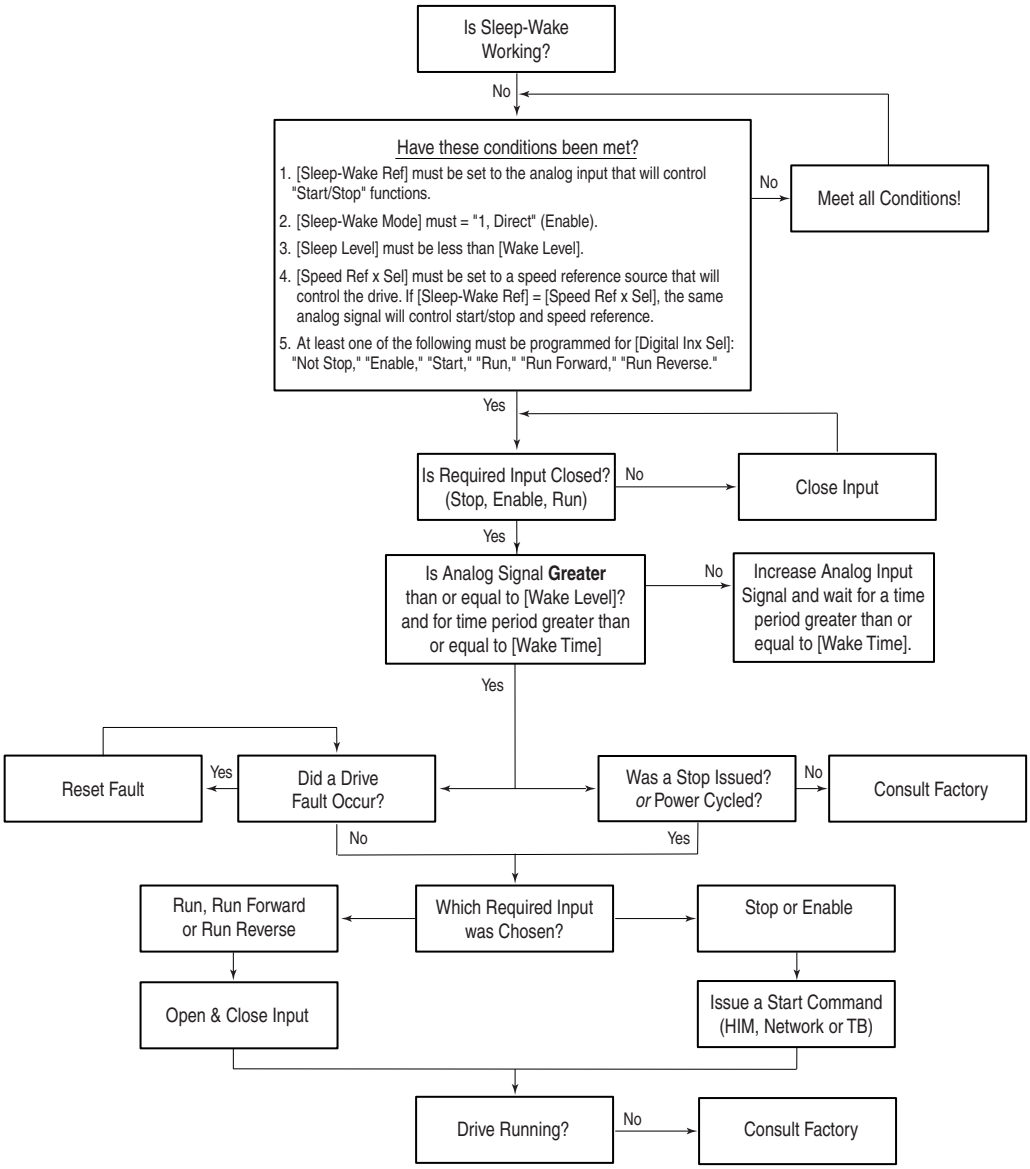
Definitions

- Wake - A start command generated when the analog input value remains above [Wake Level] (or below when Invert mode is active) for a time greater than [Wake Time].
- Sleep - A Stop command generated when the analog input value remains below [Sleep Level] (or above when Invert mode is active) for a time greater than [Sleep Time].
- Speed Reference – The active speed command to the drive as selected by drive logic and [Speed Ref x Sel].

- Start Command - A command generated by pressing the Start button on the HIM, closing a digital input programmed for Start, Run, Run Forward or Run Reverse.

Refer to Figure D.6.

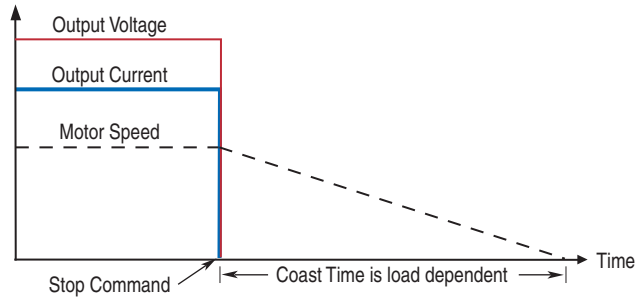
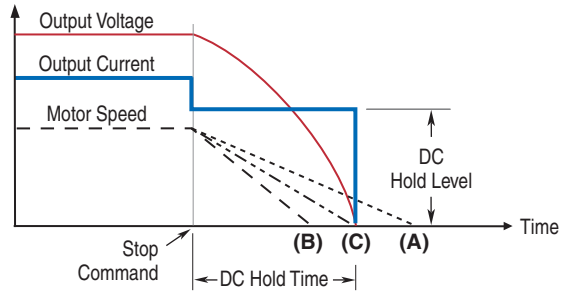
Figure D.6 Sleep Wake Mode Flow Chart

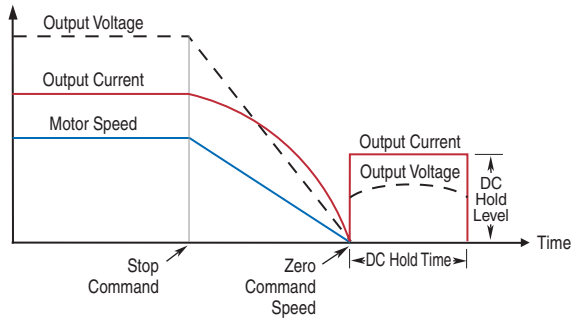
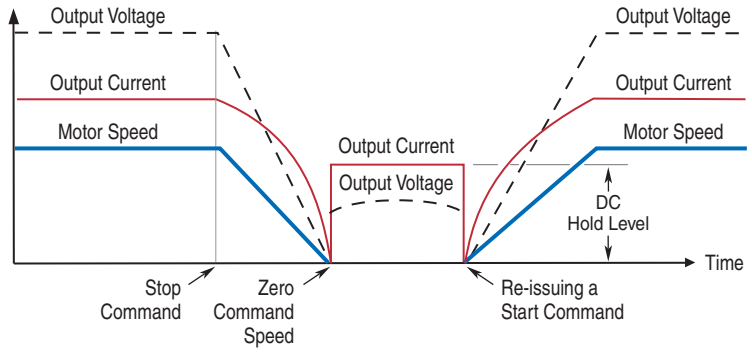

Is Sleep-Wake Working?
No
Have these conditions been met?
1. [Sleep-Wake Ref] must be set to the analog input that will control "Start/Stop" functions.
2. [Sleep-Wake Mode] must = "1, Direct" (Enable).
3. [Sleep Level] must be less than [Wake Level].
4. [Speed Ref x Sel] must be set to a speed reference source that will control the drive. If [Sleep-Wake Ref] = [Speed Ref x Sel], the same analog signal will control start/stop and speed reference.
5. At least one of the following must be programmed for [Digital Inx Sel]: "Not Stop," "Enable," "Start," "Run," "Run Forward," "Run Reverse."
No
Meet all Conditions!
Yes
Is Required Input Closed? (Stop, Enable, Run)
No
Close Input
Yes
Is Analog Signal Greater than or equal to [Wake Level]? and for time period greater than or equal to [Wake Time]
No
Increase Analog Input Signal and wait for a time period greater than or equal to [Wake Time].
Yes
Reset Fault
Yes
Did a Drive Fault Occur?
Was a Stop Issued? or Power Cycled?
No
Consult Factory
No
Yes
Run, Run Forward or Run Reverse
Which Required Input was Chosen?
Stop or Enable
Open & Close Input
Issue a Start Command (HIM, Network or TB)
Drive Running?
No
Consult Factory

Start At PowerUp

When Start At Powerup in 2 wire control is configured, the drive will start if the start permissive conditions are met within 10 seconds of drive power being applied. An alarm will be annunciated from application of power until the drive actually starts, indicating the powerup start attempt is in progress. If the drive has not started within the 10 second interval, the powerup start attempt will be terminated.

Stop Mode

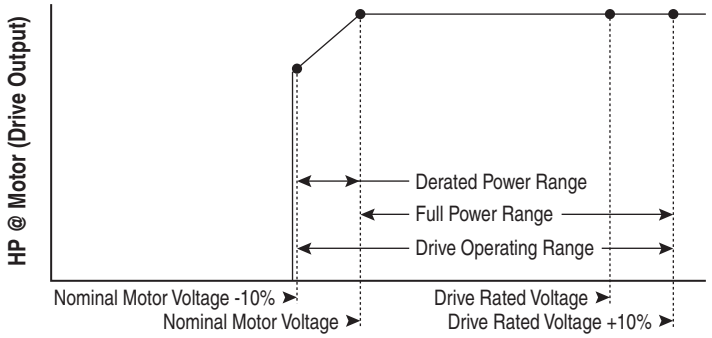
Mode	Description
Coast to Stop	 This method releases the motor and allows the load to stop by friction. 1. On Stop, the drive output goes immediately to zero (off). 2. No further power is supplied to the motor. The drive has released control. 3. The motor will coast for a time that is dependent on the mechanics of the system (inertia, friction, etc).
Brake to Stop	 This method uses DC injection of the motor to Stop and/or hold the load. 1. On Stop, 3 phase drive output goes to zero (off) 2. Drive outputs DC voltage on the last used phase at the level programmed in [DC Brake Level] Par 158. This voltage causes a “stopping” brake torque. If the voltage is applied for a time that is longer than the actual possible stopping time, the remaining time will be used to attempt to hold the motor at zero speed. 3. DC voltage to the motor continues for the amount of time programmed in [DC Brake Time] Par 159. Braking ceases after this time expires. 4. After the DC Braking ceases, no further power is supplied to the motor. The motor may or may not be stopped. The drive has released control. 5. The motor, if rotating, will coast from its present speed for a time that is dependent on the mechanics of the system (inertia, friction, etc).

Mode	Description
Ramp to Stop	 This method uses drive output reduction to stop the load. 1. On Stop, drive output will decrease according to the programmed pattern from its present value to zero. The pattern may be linear or squared. The output will decrease to zero at the rate determined by the programmed [Maximum Freq] and the programmed active [Decel Time x]. 2. The reduction in output can be limited by other drive factors such as such as bus or current regulation. 3. When the output reaches zero the output is shut off. 4. The motor, if rotating, will coast from its present speed for a time that is dependent on the mechanics of the system (inertia, friction, etc).
Ramp to Hold	 This method combines two of the methods above. It uses drive output reduction to stop the load and DC injection to hold the load at zero speed once it has stopped. 1. On Stop, drive output will decrease according to the programmed pattern from its present value to zero. The pattern may be linear or squared. The output will decrease to zero at the rate determined by the programmed [Maximum Freq] and the programmed active [Decel Time x] 2. The reduction in output can be limited by other drive factors such as bus or current regulation. 3. When the output reaches zero 3 phase drive output goes to zero (off) and the drive outputs DC voltage on the last used phase at the level programmed in [DC Brake Level] Par 158. This voltage causes a “holding” brake torque. 4. DC voltage to the motor continues until a Start command is reissued or the drive is disabled. 5. If a Start command is reissued, DC Braking ceases and he drive returns to normal AC operation. If an Enable command is removed, the drive enters a “not ready” state until the enable is restored.

Voltage Tolerance

Drive Rating	Nominal Line Voltage	Nominal Motor Voltage	Drive Full Power Range	Drive Operating Range
200-240	200	200*	200-264	180-264
	208	208	208-264	
	240	230	230-264	
380-400	380	380*	380-528	342-528
	400	400	400-528	
	480	460	460-528	
500-600 *(Frames 0-4 Only)*	600	575*	575-660	432-660
500-690 *(Frames 5-6 Only)*	600	575*	575-660	475-759
	690	690	690-759	475-759

Drive Full Power Range =	Nominal Motor Voltage to Drive Rated Voltage +10%. Rated power is available across the entire Drive Full Power Range.
Drive Operating Range =	Lowest (*) Nominal Motor Voltage –10% to Drive Rated Voltage +10%. Drive Output is linearly derated when Actual Line Voltage is less than the Nominal Motor Voltage.

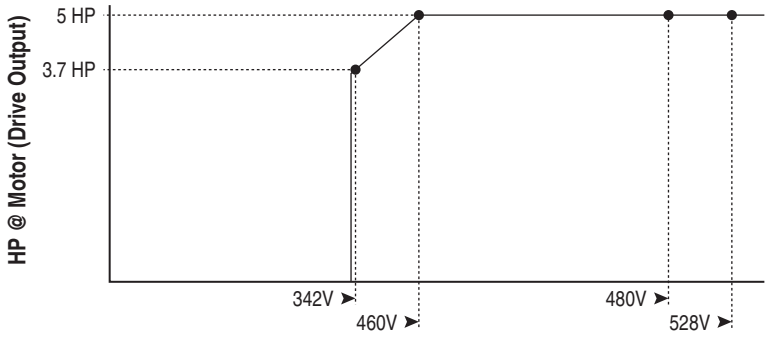


Example:

Calculate the maximum power of a 5 HP, 460V motor connected to a 480V rated drive supplied with 342V Actual Line Voltage input.

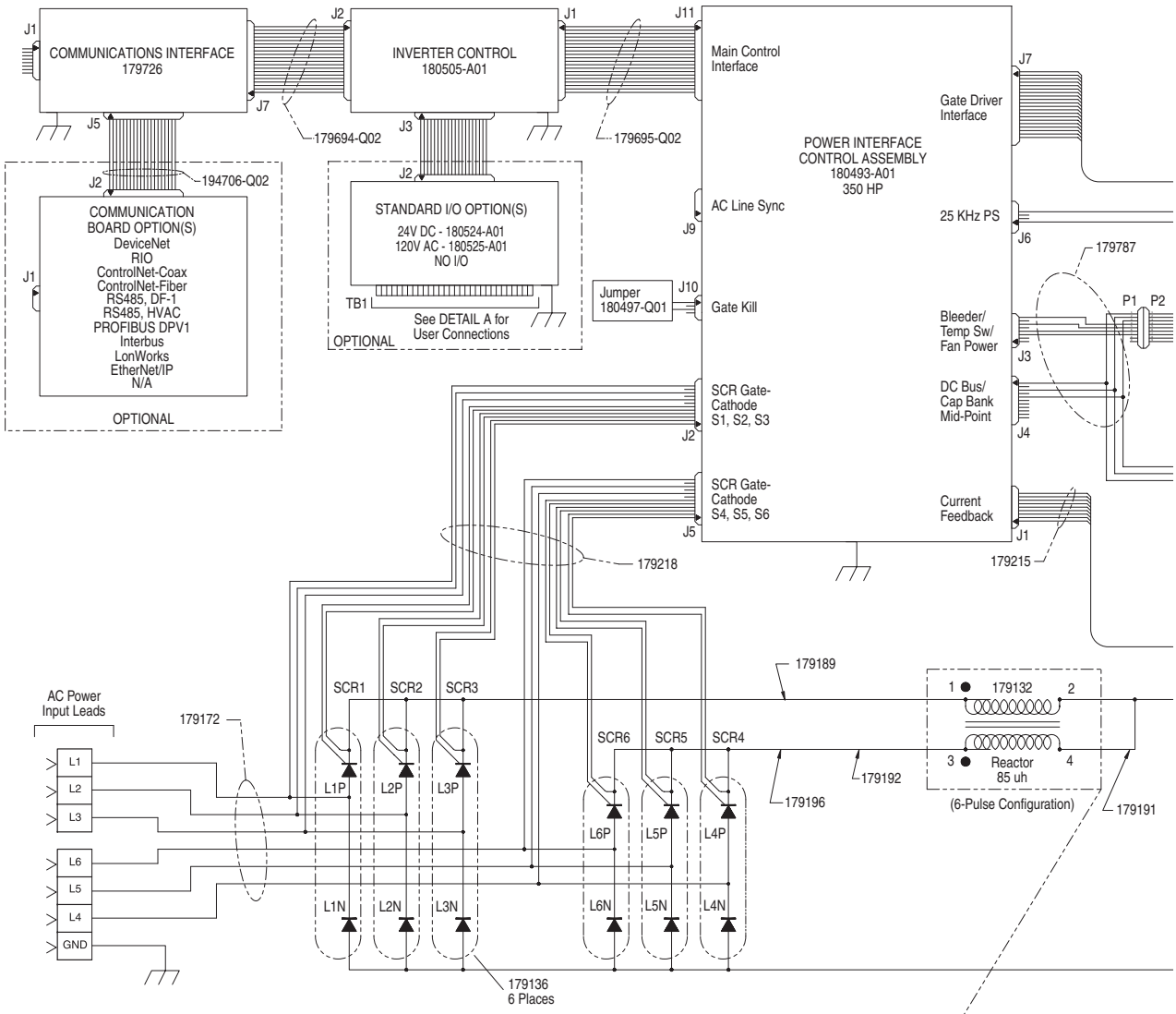
- Actual Line Voltage / Nominal Motor Voltage = 74.3%
- 74.3% × 5 HP = 3.7 HP
- 74.3% × 60 Hz = 44.6 Hz

At 342V Actual Line Voltage, the maximum power the 5 HP, 460V motor can produce is 3.7 HP at 44.6 Hz.



B-Frame LPM15 Drive Wiring Diagram

See pages E-2 and E-3 for wiring diagram.

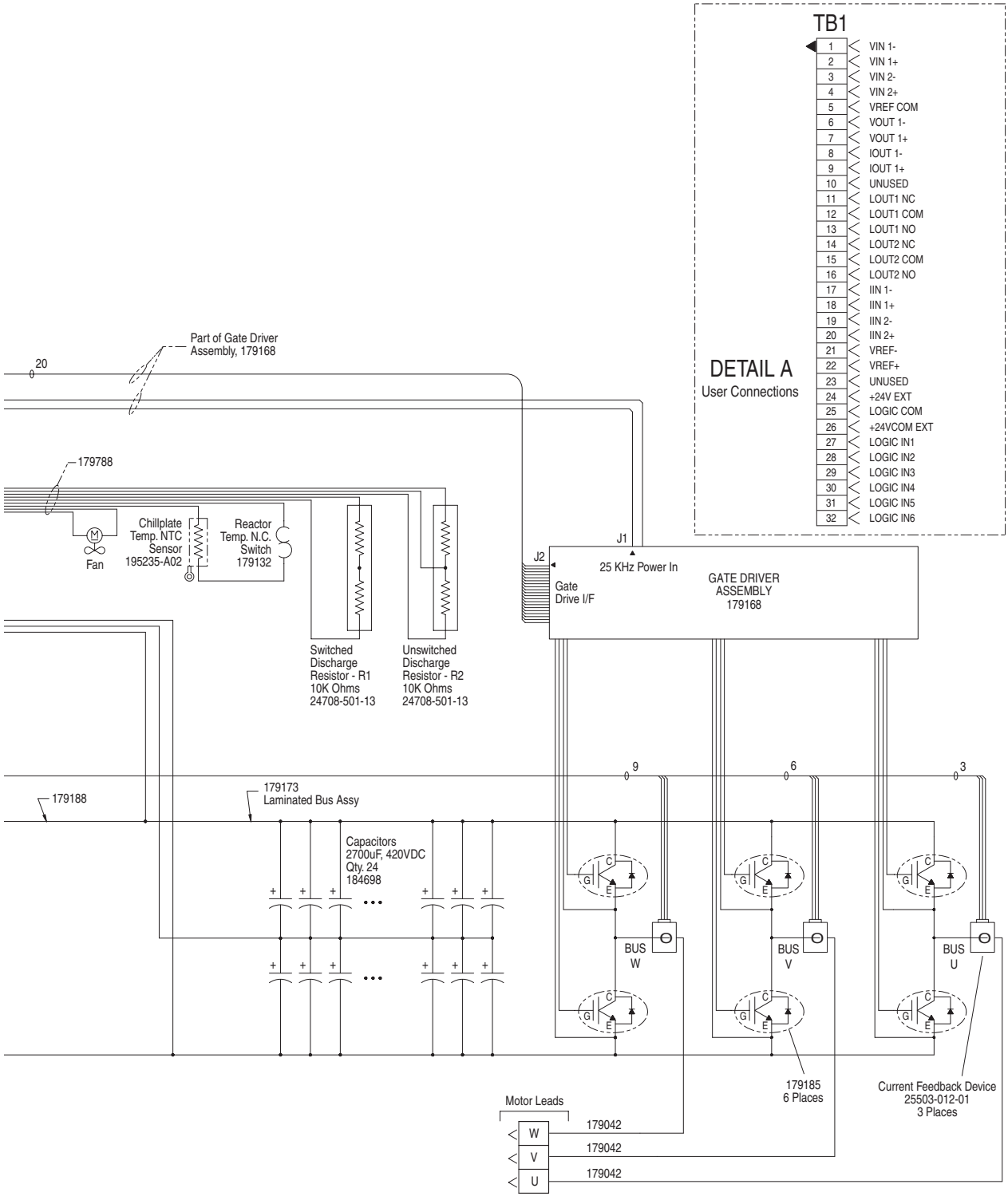


NOTES:

▲ 1.) Symbol designates PIN 1 location of connectors.

2.) For S6 hookup: L1 is connected to L4.
L2 is connected to L5.
L3 is connected to L6.

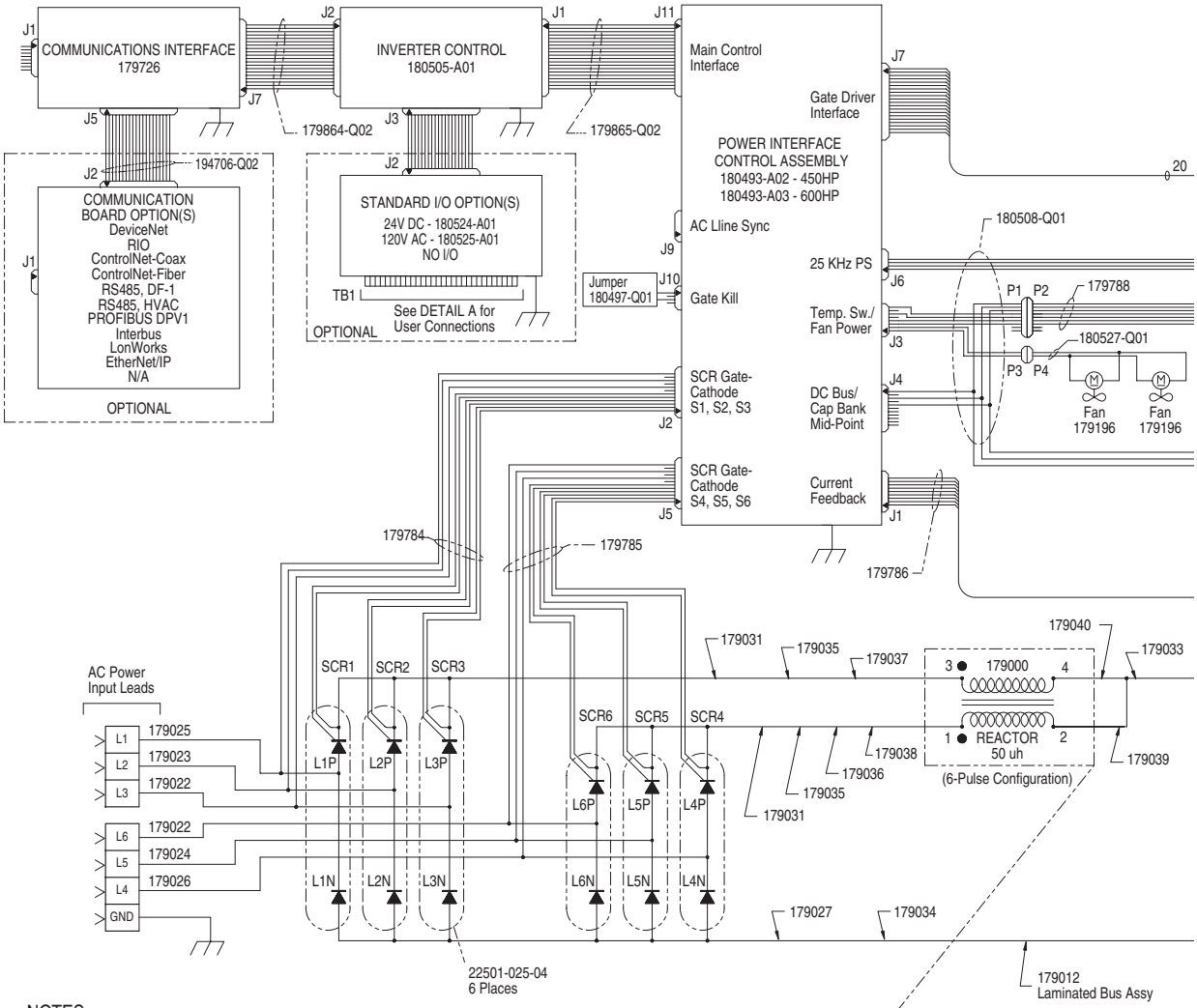
3.) For S12 hookup: AC power is attached individually to L1 thru L6.


TB1
1 VIN 1-
2 VIN 1+
3 VIN 2-
4 VIN 2+
5 VREF COM
6 VOUT 1-
7 VOUT 1+
8 IOUT 1-
9 IOUT 1+
10 UNUSED
11 LOUT1 NC
12 LOUT1 COM
13 LOUT1 NO
14 LOUT2 NC
15 LOUT2 COM
16 LOUT2 NO
17 IIN 1-
18 IIN 1+
19 IIN 2-
20 IIN 2+
21 VREF-
22 VREF+
23 UNUSED
24 +24V EXT
25 LOGIC COM
26 +24VCOM EXT
27 LOGIC IN1
28 LOGIC IN2
29 LOGIC IN3
30 LOGIC IN4
31 LOGIC IN5
32 LOGIC IN6
DETAIL A
User Connections
Part of Gate Driver Assembly, 179168
20
179788
Chillplate Temp. NTC Sensor 195235-A02
Fan
Reactor Temp. N.C. Switch 179132
Switched Discharge Resistor - R1 10K Ohms 24708-501-13
Unswitched Discharge Resistor - R2 10K Ohms 24708-501-13
J1
J2
25 KHz Power In
Gate Drive I/F
GATE DRIVER ASSEMBLY 179168
9
6
3
179188
179173 Laminated Bus Assy
Capacitors 2700uF, 420VDC Qty. 24 184698
BUS W
BUS V
BUS U
179185 6 Places
Current Feedback Device 25503-012-01 3 Places
Motor Leads
W
V
U
179042
179042
179042

Notes:

C-Frame LPM15 Drive Wiring Diagram

See pages F-2 and F-3 for wiring diagram.

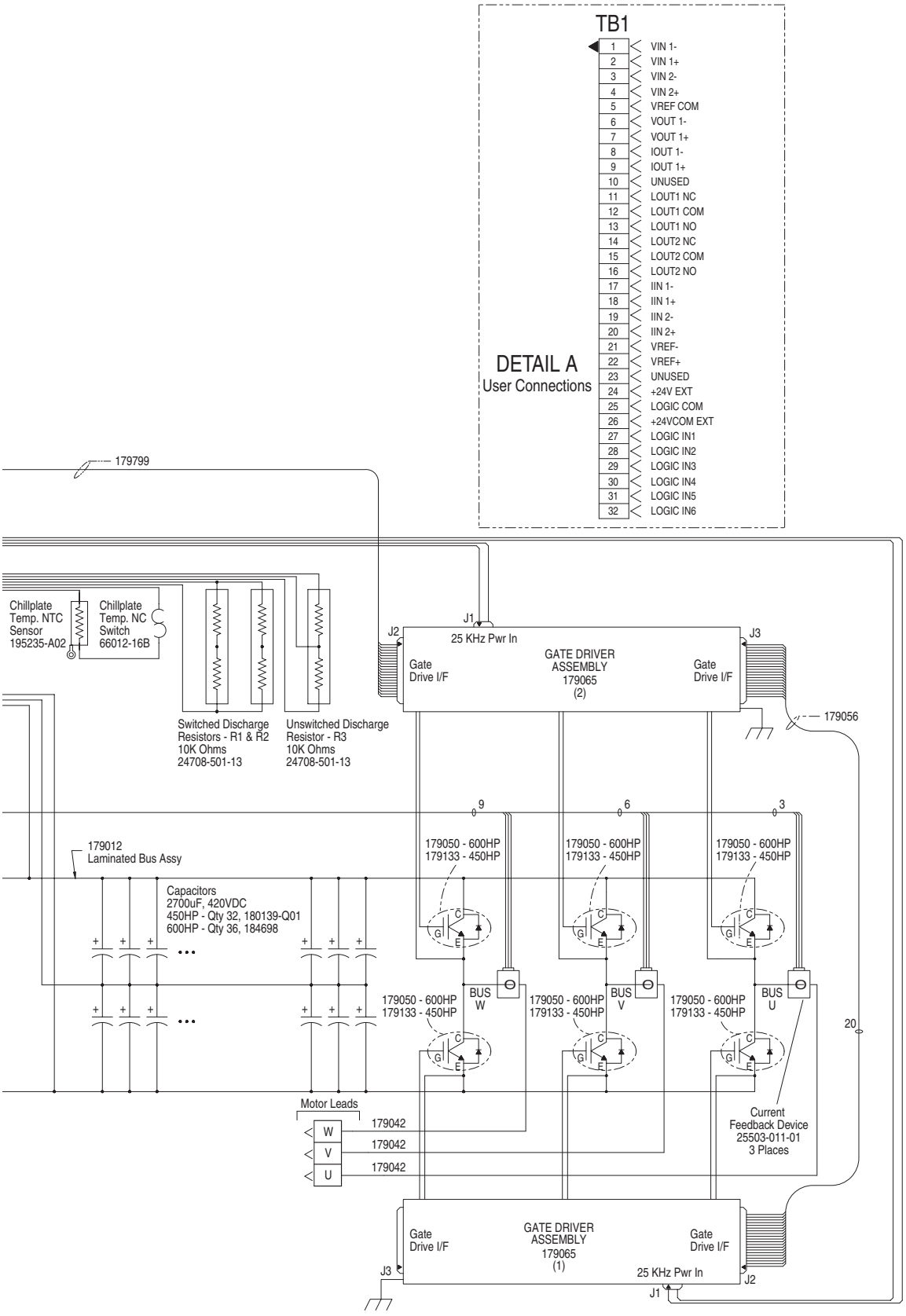


NOTES:

▲ 1.) Symbol designates PIN 1 location of connectors.

2.) For S6 hookup: L1 is connected to L4.
L2 is connected to L5.
L3 is connected to L6.

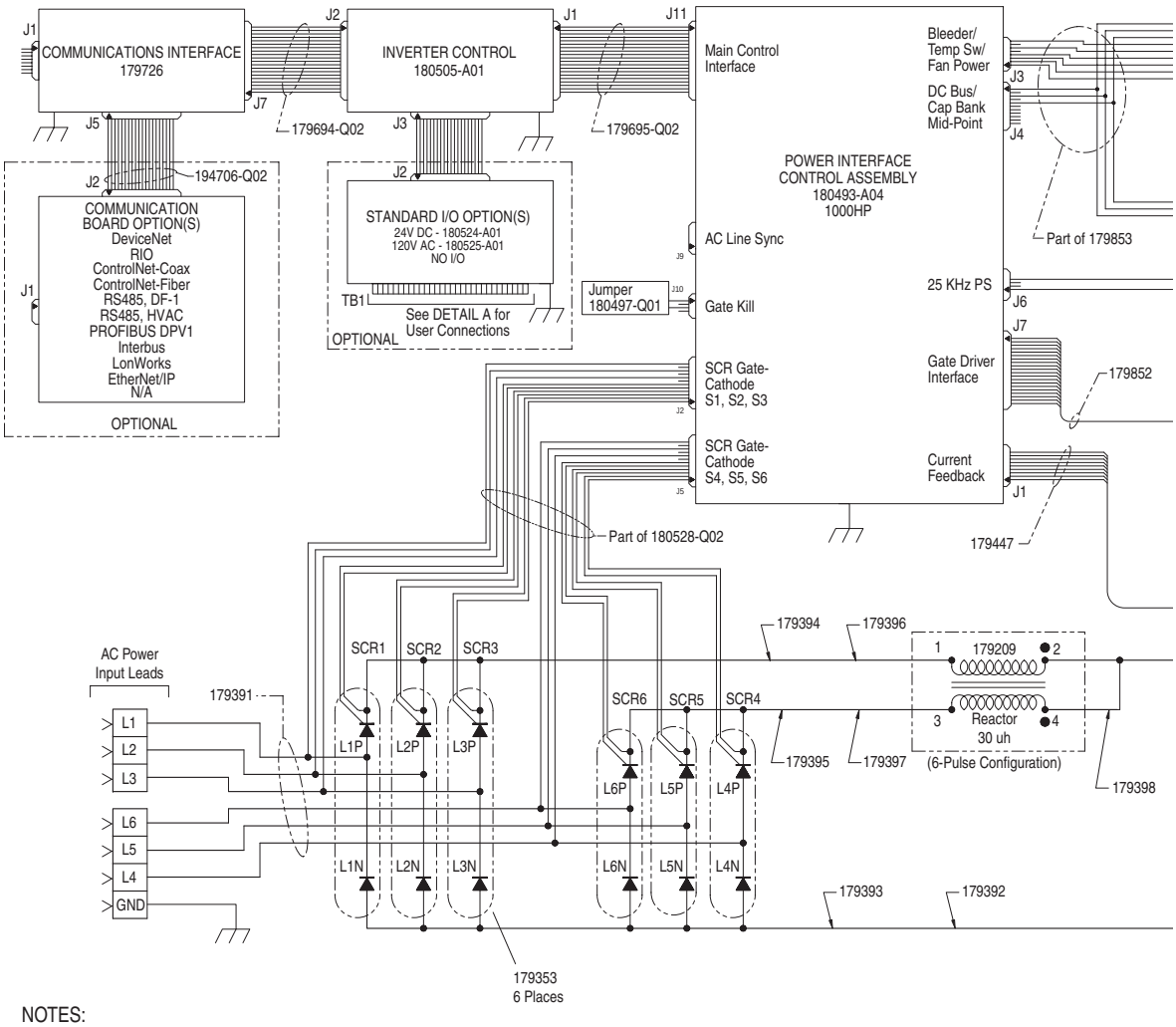
3.) For S12 hookup: AC power is attached individually to L1 thru L6.


TB1
1 VIN 1-
2 VIN 1+
3 VIN 2-
4 VIN 2+
5 VREF COM
6 VOUT 1-
7 VOUT 1+
8 IOUT 1-
9 IOUT 1+
10 UNUSED
11 LOUT1 NC
12 LOUT1 COM
13 LOUT1 NO
14 LOUT2 NC
15 LOUT2 COM
16 LOUT2 NO
17 IIN 1-
18 IIN 1+
19 IIN 2-
20 IIN 2+
21 VREF-
22 VREF+
23 UNUSED
24 +24V EXT
25 LOGIC COM
26 +24VCOM EXT
27 LOGIC IN1
28 LOGIC IN2
29 LOGIC IN3
30 LOGIC IN4
31 LOGIC IN5
32 LOGIC IN6
DETAIL A
User Connections
179799
Chillplate Temp. NTC Sensor 195235-A02
Chillplate Temp. NC Switch 66012-16B
Switched Discharge Resistors - R1 & R2 10K Ohms 24708-501-13
Unswitched Discharge Resistor - R3 10K Ohms 24708-501-13
J1
J2
J3
25 KHz Pwr In
Gate Drive I/F
GATE DRIVER ASSEMBLY 179065 (2)
Gate Drive I/F
179056
9
6
3
179012 Laminated Bus Assy
Capacitors 2700uF, 420VDC 450HP - Qty 32, 180139-Q01 600HP - Qty 36, 184698
179050 - 600HP 179133 - 450HP
BUS W
BUS V
BUS U
20
Motor Leads
W
V
U
179042
179042
179042
Current Feedback Device 25503-011-01 3 Places
Gate Drive I/F
GATE DRIVER ASSEMBLY 179065 (1)
Gate Drive I/F
J3
25 KHz Pwr In
J2
J1

Notes:

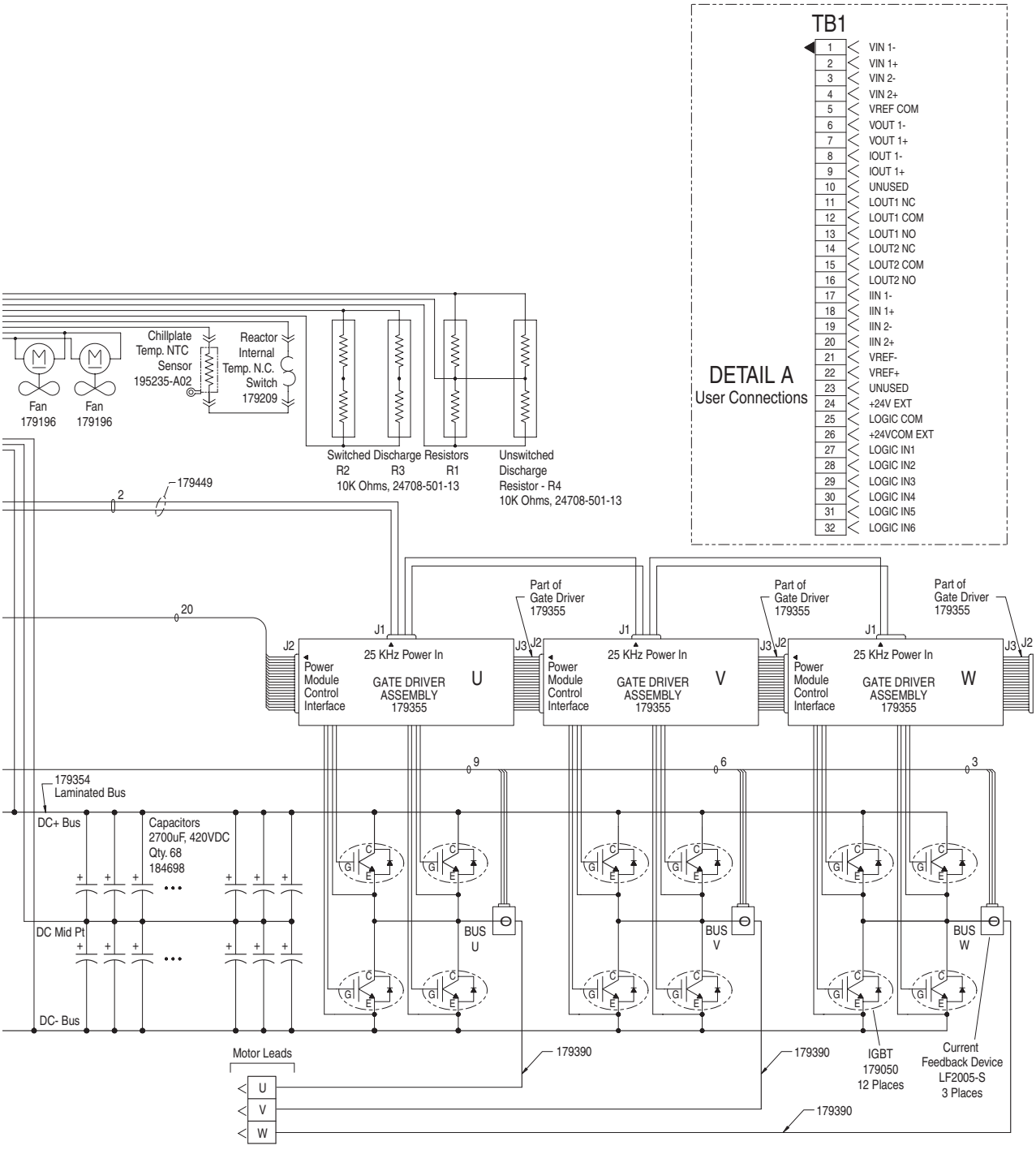
D-Frame LPM15 Drive Wiring Diagram

See pages G-2 and G-3 for wiring diagram.



NOTES:

▲ 1.) Symbol designates PIN 1 location of connectors.


TB1
1 VIN 1-
2 VIN 1+
3 VIN 2-
4 VIN 2+
5 VREF COM
6 VOUT 1-
7 VOUT 1+
8 IOUT 1-
9 IOUT 1+
10 UNUSED
11 LOUT1 NC
12 LOUT1 COM
13 LOUT1 NO
14 LOUT2 NC
15 LOUT2 COM
16 LOUT2 NO
17 IIN 1-
18 IIN 1+
19 IIN 2-
20 IIN 2+
21 VREF-
22 VREF+
23 UNUSED
24 +24V EXT
25 LOGIC COM
26 +24VCOM EXT
27 LOGIC IN1
28 LOGIC IN2
29 LOGIC IN3
30 LOGIC IN4
31 LOGIC IN5
32 LOGIC IN6
DETAIL A
User Connections
Chillplate Temp. NTC Sensor 195235-A02
Reactor Internal Temp. N.C. Switch 179209
Fan 179196
Fan 179196
Switched Discharge Resistors
R2 R3 R1
10K Ohms, 24708-501-13
Unswitched Discharge Resistor - R4
10K Ohms, 24708-501-13
179449
2
20
Part of Gate Driver 179355
Part of Gate Driver 179355
Part of Gate Driver 179355
J1
J2
J3
25 KHz Power In
Power Module Control Interface
GATE DRIVER ASSEMBLY 179355
U
V
W
9
6
3
179354 Laminated Bus
DC+ Bus
DC Mid Pt
DC- Bus
Capacitors 2700uF, 420VDC Qty. 68 184698
BUS U
BUS V
BUS W
Motor Leads
U
V
W
179390
179390
179390
IGBT 179050 12 Places
Current Feedback Device LF2005-S 3 Places

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